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INDIGENOUS DRUGS OF INDIA

INDIGENOUS DRUGS OF INDIA

THEIR MEDICAL AND ECONOMIC ASPECTS

BY

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"Come, Wander with me" she said,
"Into regions yet untrod,
And read what is still unread
In the manuscripts of God."

' ngfellow.

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TO

SIR R. N. MOOKERJEE

K.C.I.E., K.C.V.O., D.Sc.,
M.I.E. (Ind.), M.I.M.E.,
F.A.S.B.

WITH GRATITUDE AND AFFECTION

PREFACE

Although in the past a number of treatises on the subject of the Indian Indigenous Drugs have appeared, no apology is needed for presenting a new book to the reader. The subject is old, but it has not lost its interest with time. On the other hand there is reason to believe that it is attracting more attention from the medical profession and the general public. It is thought that from the vast array of the materia medica of the indigenous systems, investigation and research might bring to the scientific world many useful remedies for the alleviation of human sufferings. Although a systematic study of the indigenous drugs was begun nearly a century ago and admirable attempts were made by the early European and Indian workers, the progress has been slow. The reason is not far to seek. Scientific methods of chemical investigation of plants have only been known during the last thirty years or so. Properly equipped laboratories for carrying out the physiological and pharmacological tests did not exist in India till recently, and lastly the critical evaluation of therapeutic remedies was not possible for want of suitable research hospitals. As the Professor of Pharmacology at the Calcutta School of Tropical Medicine and as a Physician to the Carmichael Hospital for Tropical Diseases, I have had the good fortune of not only having well equipped chemical and pharmacological laboratories at my disposal, but also facilities for carrying out clinical trials. Collaboration with and help of colleagues at the School, experts in all the various important branches of medicine, made the task less difficult. The generous grants given to me by the Indian Research Fund Association enabled me to study these drugs through all the different stages.

In this volume an attempt has been made to present these observations to the medical profession, research workers, pharmaceutical chemists and manufacturers. Though the book has been based mainly on the work done by myself and my colleagues in the Department of Pharmacology and Chemistry,

a résumé of practically all recent investigations on the subject of Indian Indigenous Drugs has also been included for the convenience of the reader.

The book is divided into five parts. The first part is entirely devoted to general considerations regarding the necessity of research into the vast domain of the indigenous drugs, with special reference to the problems which presented themselves to me during the course of this work. The term 'indigenous drugs' has been used in a comprehensive sense and has been taken to include not merely those drugs which were originally the natives of India, but also the exotics which have been cultivated at some time or other and have become completely naturalised to the soil. The lines on which efforts of the worker should be directed in order to achieve useful results have been clearly indicated. The methods of effecting economy so as to bring the treatment of disease within the means of the poor masses in India, and the desirability of using crude drugs, which are cheaper, in place of the refined and finished preparations, have been discussed. A special reference has been made to the cultivation of important medicinal plants in India. This part, it is confidently hoped, will provide much food for thought to all those who are interested in the study of the Indian medicinal plants and in making the country self-supporting so far as the medicinal drugs are concerned.

The second part deals with the pharmacopœial and allied drugs. No effort has been made here to present the botanical, chemical, pharmacological and therapeutic details which can be found in any of the standard works. It has been my aim throughout this section to draw the attention of the reader to the enormous possibilities which exist with regard to this group of drugs and which if worked up might be of great economic benefit to the country. This phase of the problem of the indigenous drugs has thus far received little or no attention from the professions of medicine and pharmacy in our country.

The third part deals with the drugs used in the indigenous medicine. The chief object here has been to present to the reader a short account of the chemical composition, the pharmacological action and therapeutic uses of these drugs. This,

it is hoped, will help the medical practitioners and others interested to judge the merits and demerits of a particular drug and to decide whether to use it or not. No attempt has been made in this section to give all the general information available in the old literature. For such information the reader is referred to such excellent works as Dymock's *Pharmacographia Indica*, Watt's *Dictionary of the Economic Products of India*, Kirtikar and Basu's *Indian Medicinal Plants*, etc. Nor is it intended to enter much into the province of the systematic botanist and pharmacognosist. Only such botanical and descriptive data have been given as are absolutely necessary for ordinary purposes.

In Part IV a glossary of all medicinal plants growing in India has been given. This is by far the most complete list so far prepared and includes over two thousand plants. The active principles contained and the purposes for which they are used in the indigenous medicine are briefly indicated. References to any work published are given. In addition to medicinal plants this part contains a short description of drugs of animal and mineral origin used in the indigenous systems of medicine. Lists of plants containing poisonous principles and plant remedies used in the treatment of snake-bite and scorpion-sting have been included.

Part V gives a short description of the common bazar medicines of India, their important vernacular names and their popular uses. After this a separate index of the commonly used vernacular names has been provided. This will enable the reader to trace a drug if he knows one of the common names by which it is known in any part of India.

The present volume owes its inception to an invitation extended to me by the Patna University to deliver a course of lectures in connection with the Sukhraj Ray Readership in Natural Science during 1929-30. The medical and economic aspects of some Indian medicinal plants formed the theme of these lectures. The interest evinced in the subject has been shown by the fact that letters and enquiries have been pouring in from all parts of India. For this reason the idea of extending the scope and presenting the subject matter in book

form was conceived. This idea, however, could not be put into a practical shape for some time as I went on deputation as Chairman of the Drugs Enquiry Committee appointed by the Government of India to consider the question of the quality of medicinal drugs on the Indian market. Personal contact with the professions of medicine and pharmacy during my all-India tour further impressed on me the necessity and utility of such a publication. On the nucleus of the Patna lectures, therefore, the present superstructure has been built. In its general plan and arrangement, the present volume bears a close resemblance to the lectures originally delivered but considerable amount of new material has been added. I take this opportunity of conveying my deep sense of appreciation to the authorities of the Patna University.

I have very great pleasure in acknowledging the assistance I have received in writing this book from Dr. B. Mukherji, my former pupil and now my assistant in the Department of Pharmacology and Dr. S. Ghosh, Professor of Chemistry. But for the great interest taken in this work by all the members of the staff of the two departments it would not have been possible for me to complete the work in such a short time. They have helped in the compilation of the list of indigenous drugs, in the collection of references and in the preparation of the index. This has been a very tedious and laborious work. Dr. I. B. Bose has rendered valuable assistance in finally checking references, scrutinizing the proofs and in getting the book through the press. To all these workers I am very grateful. To Dr. L. E. Napier and Lieut.-Col. R. Knowles I owe a great debt of gratitude for the critical reading of the proofs and for valuable suggestions which have saved the book from many blemishes. I wish to convey my deep sense of appreciation to Lieut.-Col. H. W. Acton, C.I.E., I.M.S., Director of the School of Tropical Medicine, who initiated me to research, the outcome of which is the present volume. His advice at every stage of this work has been invaluable. I also wish to place on record the encouragement given to the study of the Indian Indigenous Drugs by the Governing Body of the Indian Research Fund Association, Major-General J. W. D.

Megaw, C.I.E., K.H.P., I.M.S., formerly Director of the School and now the Director-General of the Indian Medical Service, and Major-General J. D. Graham, C.B., C.I.E., K.H.S., I.M.S., Secretary of the Association. To the editors of the *Indian Medical Gazette* and *Indian Journal of Medical Research*, the two periodicals in which most of my work on the indigenous drugs has been published, I am grateful for permission to make use of the papers for the purposes of the book. Those who are interested in details of this work would be well advised to read the original papers, references to which are all given in the book. To Mr. N. Mukherjee and staff of the Art Press I am grateful for the care they have bestowed in printing and publishing this volume.

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PART I

THE MEDICAL AND ECONOMIC ASPECTS OF INDIAN INDIGENOUS DRUGS

I

HISTORICAL AND GENERAL:—It is desirable to point out at the outset that the term 'Indigenous Drugs' has been used in its widest sense so as to include within its scope not merely those drugs which were originally the natives of India but also those which have been introduced from outside and have become completely naturalised. Drugs which are cultivated in India, whether used in the indigenous systems of medicine or in the pharmacopœias of various western countries, have also been brought within the purview of that expression.

The Indian indigenous drugs have great importance both from the professional and economic points of view. Medicine is a very ancient art, and drugs have been used in days of antiquity as far back as history can take us. It is impossible to think of medicine as something not connected with treatment, and drugs have formed an integral part of treatment from the commencement of human memory.

The Antiquity of Indian Materia Medica:—The history of medicine in India can be traced to the remote past. The earliest mention of the medicinal use of plants is to be found in the Rig Veda, which is one of the oldest, if not the oldest, repositories of human knowledge, having been written between 4,500 and 1,600 B. C. In this work mention has been made of the Soma plant and its effects on man. In the Atharva Veda, which is a later production, the use of drugs is more varied although it takes the form, in many instances, of charms, amulets, etc. It is in the Ayurveda, which is considered as an Upaveda (or supplementary hymns designed for the more detailed instruction of the mankind), that definite properties of drugs and their uses have been given in some detail. Ayurveda, in fact, is the very foundation stone of the

ancient medical science of India. It has got eight divisions which deal with different aspects of the science of life and the art of healing. The age of Ayurveda is fixed by various Western scholars somewhere about 2,500 B. C. to 600 B. C. The eight divisions of the Ayurveda were followed by two works written later, *i.e.* Susruta and Charaka. About the date of Susruta there is a great deal of uncertainty but it could not have been written later than 1,000 B. C. In this work surgery is dealt with in detail but there is a comprehensive chapter on therapeutics. Charaka, written about the same period, deals more with medicine and its seventh chapter is taken up entirely with the consideration of purgatives and emetics. In the twelve chapters there is to be found a remarkable description of materia medica as it was known to the ancient Hindus. The simple medicines alone are arranged by this author under forty-five heads. The methods of administration of drugs are fully described and bear a striking resemblance to those in use at the present time; even administration of medicaments by injections for various diseased conditions has not failed to attract notice and attention. From Susruta and Charaka various systems dealing with different branches of medicine sprang up. Dr. Wise (1845) mentions two systems of Hindu surgery and nine systems of medicine, three of materia medica, one of posology, one of pharmacy and three of metallic preparations alone. From these one can gather the strength and dimensions of the scientific knowledge of ancient India regarding therapeutic agents both of organic and inorganic origin. Even anæsthetics in some form or other were not unknown. 'Bhoja-prabandha', a treatise written about 980 A.D., contains a reference to inhalation of medicaments before surgical operations and an anæsthetic called 'Sammohini' is said to have been used in the time of Buddha.

From this period down to the Mohammedan invasion of India, Hindu medicine flourished. Its progress may briefly be traced through four distinct stages, namely (1) the Vedic period, (2) the period of original research and classical authors, (3) the period of compilers and also of Tantras and Siddhas (Chemist-physicians), and (4) the period of decay and

recompilation. During the second and third periods the progress was remarkable in every respect and Ayurveda then attained its highest development. Towards the close of this period Ayurvedic medicine made its way far beyond the limits of India. The nations of the civilised world of that time eagerly sought to obtain information regarding the healing art from the Hindus of those times, the influence of Hindu medicine permeated far and wide into Egypt, Greece and Rome and moulded the Greek and Roman medicine and through the former, Arabic medicine also. Jacolliot very rightly and pertinently remarked, "We should not forget that India, that immense and luminous centre in olden times, was in constant communication with all the peoples of Asia and that all the philosophers and sages of antiquity went there to study the science of life". There are unmistakable evidences in the Grecian and Roman medicine of the influence of Hindu medicine. Hellenic civilisation came most intimately in contact with Indian civilisation through the conquests of Alexander the Great. During this period Indian medicine was at its zenith and the knowledge of the Hindu physicians in the domain of drug therapy and toxicology was far in advance of others. They made an immense study of the properties of every product of the soil and systematically devoted their attention to the study of disease and its treatment with drugs. The skill of these physicians in curing snake bites and other ailments among the soldiers of the Grecian camp bears testimony to this. No wonder then that the Grecian medicine imbibed in a large measure the knowledge of the healing science and enriched its materia medica from those of the Hindus. There is reason to believe that many Greek philosophers like Paracelsus, Hippocrates and Pythagoras actually visited the East and helped in the transmission of Hindu culture to their own countries. The work of the great physician Dioscoroides definitely shows to what extent the ancients were indebted to India and the East for their medicine. Many Indian plants are mentioned in his first work, particularly the aromatic group of drugs for which India has always been famed. The smoking of datura in cases of asthma, the use

of nux vomica in paralysis and dyspepsia, and the use of croton as a purgative can be definitely traced to have originated from ancient India. Even the effects produced by excessive smoking of datura came to their notice.

The Romans also took a great interest in Indian drugs. There is evidence to show that an external trade in Indian drugs existed between India and Rome many centuries ago The country, with enormous variabilities of climate and with such wonderful ranges of mountains as the Himalayas was, from the earliest times, recognised as a rich nursery of the vegetable materia medica. In the days of Pliny, this drug traffic assumed such enormous proportions that he actually complained of the heavy drain of Roman gold to India in buying costly Indian drugs and spices. The following extract from the writing of an English student of Oriental literature will be of interest in this connection. In the course of a lecture, Captain Johnston Saint, M.A., mentioned the extraordinary advance made both in surgery and medicine in India when Europe was groping for light in her cradle in Greece. Says he "If then this is what we found in surgery, what may we not find in medicine from India—that vast and fertile country which is a veritable encyclopædia of the vegetable world. The materia medica of the ancient Hindus is a marvel from which both the Greek and the Roman freely borrowed".

II

EVOLUTION OF THE PRESENT INDIAN INDIGENOUS DRUGS: —*Decay of Indian Medicine.*—After the period of the Tantras and Siddhas, the glories of the Hindu medicine rapidly waned and declined. During the invasion of India by the Greeks, Scythians and Mohammedans successively, no original works were written and the Hindu medicine gradually began to decay. During the disturbed times that followed, a good deal of the existing Ayurvedic literature was mutilated or lost, and degeneration became discernible everywhere. Various branches of medicine passed into the hands of priests, and drugs and herbs gave way to charms and amulets. The medicine man

himself became a member of a sub-caste of Brahmins to whom knowledge and learning were chiefly confined. A large section of them began to think that the study and practice of the healing art, specially surgery, led to pollution. To touch the dead body was considered sinful and, dissection of dead bodies being discontinued, advancement in anatomical and surgical knowledge naturally declined. The Buddhistic doctrine of 'Ahimsa' also exercised a great influence in that direction. Though surgery declined to a great extent during the Buddhistic period, medicine again made rapid progress. It was in this period that a large number of valuable drugs were added to the already extensive materia medica, and drugs began to be systematically cultivated and investigated. With the decline of Buddhism, degeneration set in all round—in knowledge, learning and practice of both medicine and surgery—and the process of decay became well advanced about the time of the Mohammedan invasion.

With the advent of the Muslim conquerors, the decline was even more rapid. The invaders brought their own healing system, which was fairly advanced for that period, and as the Mohammedan rule became established, the old Hindu or the Ayurvedic system of treatment was rapidly thrown into the background. The Arabic system thus introduced, became the State system of relief. Professor Brown, in his lectures delivered before the Royal College of Physicians, showed how greatly Arabian medicine was influenced by the Greek learning in the early centuries of the Christian era. Although the chief pursuit of the chemists about this time was the Philosopher's Stone and the Elixir of Life, they nevertheless made many real discoveries. How many of these we owe to the Arabs is apparent from such words as alcohol, alembic and the like, still current at the present time. There is no doubt that it was in the domain of chemistry and materia medica that the Arabs added most to the body of scientific doctrine which they inherited from the Greeks. Leclerc in his 'Histoire de la Medicine Arabe' points out that even a century earlier than the Arab conquest of Egypt, the process of assimilating the Greek medicine had begun. The Arabian medicine was

also influenced by the Persian Jundi-Shapor school which flourished in Persia in the 5th century A.D. This is evident from the fact that there is an undoubtedly Persian element, especially in materia medica, in which the Arabic nomenclature plainly reveals, in many instances, Persian origin. About the middle of the 8th century, when the city of Bagdad was newly founded, the great stream of ancient learning began to pour into the Mohammedan world and to reclothe itself in Arabian dress. The Mohammedan system of medicine thus brought with it a rich store of its own materia medica, quite unknown to the country.

Advent of Arabian and Western Medicine:—The Arabian or the Mohammedan medicine prevalent during the reign of the Pathan and Moghul dynasties unfortunately did not make much progress after its introduction into the country and with the fall of the Moghuls it rapidly decayed. During the intimate contact between the old Hindu medicine and the Arabian medicine, which lasted for many centuries, there was a great deal of intermingling and each utilised the materia medica of the other. The result was that, though both the systems had declined, a rich store of the combined materia medica was left behind. With the advent of Europeans—first the Portuguese, then the French and lastly the English—the decline was still further marked.

When the British rule was established, the Western system was introduced and it was primarily intended to give relief to those who administered the country. As there was no proper system of medical relief in vogue at that time, the newly introduced Western system found its way amongst the people and was welcomed by them; the appreciation and the demand for it extended all over the country, especially as its surgical achievements appealed strongly to the people and made a great effect on them. It also brought with it its own materia medica and there was further intermingling and introduction of new medicinal plants into the country.

This, in brief, is the story of the evolution of what are commonly known as the Indian indigenous drugs. A combina-

tion of all drugs from the three sources constitute the Indian indigenous drugs with which we are concerned to-day.

III

ATTEMPTS AT REVIVAL OF INDIGENOUS SYSTEMS:—The Indian systems of medicine have been regarded by many of the Western scholars interested in Oriental studies as a rich mine of knowledge from which many useful things might possibly be unearthed. It has been said that the medicine of India was permeated with the scientific spirit as evidenced by a desire, by observation and experiment, by induction and deduction, to probe the secrets of nature and to build thereon a rational system of medicine. On the other hand, contrary opinion is also not wanting that no benefit will be derived by a study of the old systems which are based mainly on empiricism rather than science. This reasoning, however, does not seem to be based on sound logic. A system which has survived to such an extent the ravages of time, cannot be entirely brushed aside as unscientific. The opinion of Dr. Hugh S. Cumming, Surgeon-General of the United States Public Health Service, is worth recalling in this connection. He has expressed the belief that any system of medicine or, for that matter, any ancient usage or custom that has held its own for generations usually has something at the back of it, no matter how little it appears to be supported by modern science. He says, "For thousands of years, the Chinese have prescribed the powdered heads of toad-fish as a remedy for heart trouble, and now adrenalin, the most up-to-date drug for the treatment of heart disease, has been found to exist in the head glands of that fish. For generations the fact that the American Indian hunters always chose the liver and the white men the meat when the animals they had trapped or killed were divided, was quoted as proof of their ignorance and primitive development. Yet in the last 5 years, the great nutritive value of liver has come to be recognised and it is prescribed in cases of anaemia". In the light of these facts, old systems cannot be summarily condemned as useless and would form fitting subjects for enquiry and investigation.

Of late years, a spirit of enquiry and research into the ancient systems has been discernible among the people of the soil. Even a distinct reaction in favour of the revival of old systems has been apparent in many parts of the country As a result of this, considerable interest has been evinced by the public and by the medical profession regarding the use of indigenous drugs in the treatment of disease. Indeed it has been argued that, apart from economic considerations, these drugs are more suited to the habits of the people and the climatic conditions that prevail in this country. The question of the restoration and development of the indigenous systems of medicine has been discussed by the legislatures of the various provinces. It has been argued that not more than 10 per cent. of the population of this vast country have access to the Western scientific medicine and that the remaining have to rely on the old systems in some form or other and on the indigenous materia medica. This fact has been fully appreciated by the authorities concerned. Lord Hardinge, in the course of an address, said, "When I remember how many millions of people in India are beyond the reach of allopathic aid provided by the Government and how many of those who had means of access to consult the best doctors still prefer to be treated in accordance with the indigenous systems of medicine, I come to the conclusion that I should be wrong to discourage the scheme which aims at improvement and development of this branch of medicine".

The difficulties, however, in the wholesale revival and development of these systems are very great and are freely acknowledged even by the learned exponents of these systems. When it is remembered that the Ayurvedic system of medicine has been practically stationary for about fifteen hundred years and that no attempt has been made to advance the knowledge in conjunction with the progress of the world, one would find it very difficult to reconcile the old theories of two thousand years ago, however much one may stretch their significance, with the recent advance of world in science. After imparting instruction to the Ayurvedic students in modern physiology, bacteriology, pathology, etc., to ask them to apply the doctrine

of *vayu, pitta, kapha,* etc., to explain the causation of disease, cannot possibly be convincing to them and can bring nothing but chaos and discord to their minds. The students trained under such a system can neither be good at one nor the other. The same is the case with the Mohammedan medicine. Attempts at the revival of these systems in their present form are bound not to succeed.

IV

Necessity for Research in Indigenous Drugs :—While it is not our object here to consider the merits of such revival we have no doubt that out of the large number of drugs used by the Kavirajes and Hakims for centuries past and still in use, there are many that deserve the reputation they have earned as cures. History shows that many of our important pharmacopœial drugs were known and were also used in some form or other possibly long before they were introduced into the Western medicine and before their actions were investigated on scientific lines. On the other hand, there are sure to be others of little therapeutic value that are given only because they are mentioned in some old manuscripts, and no one has taken the trouble to confirm the truth of these statements. Attempts must be made to separate the good ones from the useless ones and for this a systematic investigation of these drugs must be undertaken. Medicine is a progressive science; in every department an attempt is being made to replace empiricism by rationalism and nowhere is this more evident than in the science of pharmacology and therapeutics.

Thus, when it is said that a drug like *Saraca indica* (Asoka) is useful in menorrhagia or *Cephalandra indica* (Telakucha) in diabetes, or *Bœrhaavia diffusa* (Punarnava) in dropsy, the profession will not accept these assertions, as these are symptoms and signs and not diseases ; what we want to know is their particular value in these various conditions and how they help to restore the tissues to their normal condition. The scientific mind is not satisfied by mere statements, no matter from what source they originate, unless corroborated

by clinical and experimental evidence. This of course necessitates careful and laborious work, which means time and extensive study. The active principles responsible for the therapeutic action have to be isolated and worked out. The way in which the effect is brought about and the manner in which the important organs of the body are affected has to be determined by animal experiments. The question of making suitable preparations and their preservation so as to make their potency independent of climatic and seasonal variations next assumes prominence. The standardisation of drugs and preparations by chemical and biological methods of assay is an important factor to secure therapeutic uniformity so that the amount of active principle in each dose is not subjected to irregular variations. These variations, for obvious reasons, are most undesirable and may do more harm than good, especially when one is dealing with potent drugs. Fresh juices and decoctions may be efficacious but, for all practical purposes, their utility must necessarily be limited. Until these drugs are investigated on rational lines, their use by the profession in India must be restricted; while other countries not bound by these traditions will only use them when their utility is brought home to them by convincing proof.

Much more could be done in furthering the cause of indigenous medicine and making it really useful to the people in this country by a thorough study of the indigenous drugs than by wholesale revivals of the old system under vastly changed environments. The active and useful drugs should be separated from those which are inactive and worthless, and they should be brought into use for relieving the sufferings of the vast masses of humanity in this country. The economic condition of the people is so low that they often cannot afford to use the expensive medicines of the Western system which are mostly imported from outside. The result is that the majority of the ryots have either to go without them or rely on the crude drugs sold in the bazar, many of which are active, while others are devoid of the therapeutic activity they are alleged to possess.

V

HISTORICAL SURVEY OF RESEARCH IN INDIGENOUS DRUGS :—We have already traced the evolution of the indigenous drugs from the earliest Vedic times to the advent of Western medicine in India. We will now glance for a moment into the ancient Sanskrit materia medica preceding the advent of Arabic medicine. Some old Sanskrit works dealing with the classification of vegetable drugs and the utilisation of their parts in medicine as practised by the Hindu physicians of 14 or 15 centuries ago provide a most interesting reading. In books like 'Kalpastanum' elaborate classifications of drugs and medicinal plants are given. Divisions are made under such headings as tuberous and bulbous roots, barks of root, barks of trees possessing peculiar smell, leaves, flowers, fruits, seeds, acrid and stringent vegetables, milky plants, those containing gums and resins, etc. In the same work the earliest references occur respecting botanical geography, the sites and climates of different plants, the soils and seasons for collecting medicinal plants, the duration of their efficiency, the method of storage, and the weights and measures to be used in pharmacy. There is evidence to show that even in the early Buddhistic period, pharmaceutical gardens were established for growing drugs and herbs for supply to the physician. Elaborate directions are to be found regarding the manipulation of drugs, some of them by no means unworthy of methods in use at the present time. Detailed instructions are given on every conceivable point, such as the gathering time, parts to be collected, making of preparations from them, etc. Annual plants were to be collected before the ripening of the seeds, biennials in the spring and perennials in the autumn; twigs were to be of first year's growth ; the roots to be collected in the cold season, the leaves in the hot season, the barks and woods in the rains. No fewer than 26 different forms of preparations have been described including decoctions and infusions in water and milk, syrups, expressions, distillations, powders, extracts, medicated oils and fermentation products. While the knowledge of ancient Hindu physicians of medicinal herbs was very

vast and their vegetable materia medica was extensive, it is curious to note that, though undoubtedly they had picked up many herbs growing in the mountains and in the plains having remarkably potent active principles, some of the plants, quite as active, growing side by side with the others, were left untouched. Such for example has been the case with belladonna, ephedra, artemisia, etc., all of which grow in great abundance in many parts of the Himalayas and yet no notice was taken of them. Some of these very drugs were utilized by the Chinese and Arabian medical men of the corresponding periods with success. The reason for this is very difficult to understand. After the period of decay had set in, very little interest centred in the new drugs. The knowledge contained in Ayurveda and other similar books began to be considered inspired and incapable of improvement by the ingenuity of man. The result was that not only did the existing knowledge remain at a standstill for nearly fifteen centuries but much of what existed was gradually lost.

We have already referred to the high standard of medical knowledge of the Mohammedans in the 8th and 9th centuries of the Christian era. Adolf Fonahn in his 'Zur Quellenkunde der Persischen Medizin' enumerates 400 Persian works, very few of which have been published, dealing entirely or partly with medical subjects. Two of these works 'Abu Mansur Muwaffaq's Materia Medica' composed in 950 A.D. and 'Dhakhira-i-khwarazmshahi'', a system of medicine written in the 12th century are well-known. In these books materia medica is divided into three parts, the first dealing with animal products, the second with simple vegetable drugs and the third with compound medicaments. In some of these works mention has been made of drugs which produce anæsthesia before operation. In 'Shah-nama' composed early in the 11th century Caesarean section practised on Rudaba, the mother of Rustam, has been described in which wine was used to produce unconsciousness. The Arabian medicine thus brought with it a rich store of its own materia medica and its exponents paid little attention to the indigenous drug resources. With the advent of Western medicine the inquisitive mind of the Western

scholars began to probe into the mysteries of the Indian medicinal plants.

The study of Indian indigenous drugs was first begun in the early part of the last century and it was then confined chiefly to the collection of available information about various medicinal plants. The earliest contributions were from the pen of Sir William Jones who wrote a memoir entitled 'Botanical Observations on Select Plants'. This was followed in 1810 by John Fleming's 'Catalogue of Medicinal Plants', Ainslie's 'Materia Medica of Hindustan' in 1813, and Roxburgh's 'Flora Indica' in 1820. Wallich, Royle and later Mouat and Macnamara did much towards resolving the chaos which existed in the vast mass of botanical material in this country into some degree of scientific arrangement. This was followed in 1844 by O'Shaughnessy's 'Bengal Pharmacopœia' which was the first book of its kind which dealt exclusively with the properties and uses of the medicinal plants used in Bengal. In 1868 a 'Pharmacopœia of India' was published under the able editorship of Waring and it signalized a new epoch in establishing and recording the value of indigenous medicinal products. The more important drugs were officially recognised with a view to their eventual adoption in the British Pharmacopœia. As a large number of the drugs, especially those in local use, were not studied in this work, Mohideen Sheriff published his 'Supplement to the Pharmacopœia' in the following year which added considerably to the utility of Waring's work. 'Materia Medica of Madras' by the same author which was edited and published after his death by Hooper is another very useful work dealing with drugs growing in the Madras Presidency and in use there. U. C. Dutt's translation of Sanskrit Materia Medica brought into prominence the drugs used by the Hindu physicians, and Flückiger's and Hanbury's 'Pharmacographia' was another very valuable production which recorded important material relating to the medicinal products indigenous to India. The other works of comparatively recent date are Dymock's 'Materia Medica of Western India', 1883, followed by the publication of that very comprehensive book on the Indian medicinal

plants, the 'Pharmacographia Indica', in 1885 under the joint-editorship of Warden and Hooper. It is a most careful and useful compilation containing a mass of information regarding the uses of the indigenous materia medica in the Eastern and Western medicine. The most elaborate work of all is 'A Dictionary of the Economic Products of India' published in 1895 by Sir George Watt, the Reporter on the Economic Products to the Government of India. This monumental work not only gives a summary of all the previous work on the medicinal plants but every page of it teems with information regarding the use of different barks, roots, flowers, leaves and woods for different medicinal purposes. Notes are added regarding the cultivation of various drugs; the economic importance of many of them with reference to their inland and export trade is also described. The quality of the drugs produced, the parts of the country to which they belong and even the results of their clinical trials by various medical authorities are meticulously recorded. Works published still later such as Kanai Lal Dey's 'Indigenous Drugs of India' and Kirtikar and Basu's 'Indian Medicinal Plants' are largely summaries and compilations from the above mentioned literature. In the latter work, plates illustrating various important medicinal herbs are given which greatly help the worker in differentiating them from plants with which they are apt to be confused.

The literature mentioned above is very valuable, as it contains not only information from Ayurvedic and Tibbi sources, but also gives the results of personal observations and experiences of some of the writers. There is no doubt that a considerable amount of botanical investigation into the scientific names of drugs has been accomplished though more remains to be done in the case of some drugs to clear up many points with respect to their exact botanical sources. New drugs that have escaped the previous investigators require to be explored in all their details. Warden and Hooper carried out a very laborious study of the chemical composition of many of the important drugs. The Indigenous Drugs Committee did useful work and was responsible for obtaining authentic specimens

of tried remedies, making standard preparations and encouraging their use in the various Government institutions throughout the country. Besides these efforts, many individual workers have from time to time taken up some drug and tried to establish its pharmacological action by modern methods of research, but these workers have been handicapped for want of properly equipped laboratories.

Admirable as all these attempts have been, yet the pharmacology of most of the indigenous remedies remained an unexplored field till recently. The reason of this was not far to seek. Investigations of this nature require a considerable outlay of money in the form of well-equipped chemical and pharmacological laboratories, while a liberal staff of competent chemists and pharmacologists is another essential prerequisite. Medicine is now intimately related to chemistry, and the ultimate solution of most problems, whether physiological or biological, rests on some physical or chemical basis. This is forcibly presented to us in the study of the action of drugs. The importance of the co-operation of chemists at every stage of research work can only be realised by the workers themselves. If satisfactory results have to be achieved and if the work is to be carried out on the same standard as other civilised countries, the co-operation of competent chemists is essential. Besides this the time and labour required to work out the chemical composition of a single drug are enormous. This may be judged from the fact that it would take an experienced chemist several months, perhaps a year or more, to isolate in a pure state and roughly describe the nature of the different chemical constituents of a single crude drug. The determination of the chemical constitution of the active principles concerned would take a considerably longer time even if the chemist devoted his time entirely to one active principle. The isolation of a sufficient quantity of the active principles and the testing of them pharmacologically would occupy several months. The magnitude of the task of working out all the drugs used in the indigenous systems of medicine transcends all imagination. There is such an enormous field for research in this direction, and so little has been done, that it is

impossible for any one individual or any one institution to cope with it adequately. The co-operation and intimate association of a large number of sincere and devoted workers of ability is needed to find the truth. Chairs in pharmacology should be founded by the various universities and medical colleges, and facilities given for research work.

The situation must however be faced. As the action of these drugs or their active principles can only be established by a careful chemical, pharmacological and clinical study, the investigation in all the three aspects should be carried on side by side. The experimental work on the pharmacological side can be done only in laboratories well equipped with all modern appliances. None existed in this country to enable one to do the work on scientific lines till the Calcutta School of Tropical Medicine was established in 1921, one of the main duties of the Professor of Pharmacology being investigation of the indigenous drugs on scientific lines. The chemical department of this institution has a team of experienced chemists who work out the chemical composition of drugs, isolate the active principles, and hand them to the pharmacologist for determination of their action on the animal organism. The clinical testing of the drug is made possible by the Carmichael Hospital for Tropical Diseases, a research hospital attached to this institution. In this way it has been found possible to go through a number of drugs in all the varied phases of their investigation, *i.e.*, from the isolation of their active principles to the testing of their action on animals and finally to the making of suitable preparations for trial on patients, and for recording the results of therapeutic trials.

VI

THREE MAIN ASPECTS OF THE PROBLEM :—After a careful survey of the Indian medicinal plants three aspects of the problem forcibly presented themselves from scientific as well as economic points of view. The research work on indigenous drugs initiated by the author at the Calcutta School of Tropical

Medicine was, therefore, undertaken with three main objects in view:

(1) To make India self-supporting by enabling her to utilise the drugs produced in the country, and by manufacturing them in a form suitable for administration.

(2) To discover remedies from the claims of Ayurvedic, Tibbi and other indigenous sources suitable to be employed by the exponents of Western medicine.

(3) To discover the means of effecting economy, so that these remedies might fall within the means of the great masses in India whose economic condition is very low.

It is to the discussion of these three aspects which emerge from a study of the problem that the attention of the reader is invited in particular.

PHARMACOPŒIAL AND ALLIED DRUGS:—The first proposition is likely to lead to great results, because a large number of drugs which grow in this country are known both to Eastern and Western medicine and the properties and actions in many cases are also not unknown. The research here might with advantage be diverted into two main channels. Firstly, there are many drugs of established therapeutic value which are in use in the pharmacopœias of different countries. The majority of these grow wild and in great abundance in many parts of India and a certain number are even cultivated. Some of these are collected and exported, though an infinitesimal fraction of the quantity produced, to foreign countries and come back to us in the form of standardised pharmaceutical preparations and active principles in pure condition, probably at a price a hundredfold of the original crude product. A host of others grow, mature and eventually die without being put to any practical use whatsoever. There are numerous examples which will be dealt with at length in the subsequent pages but a few will suffice to illustrate the possibilities of their development.

Atropa belladonna grows in great abundance in a state of nature in the Himalayan ranges from Simla to Kashmir at an

altitude of 6,000 to 12,000 feet above the sea level. Large quantities of the root are collected in the Hazara district of the North-Western Frontier Province and during recent years have been exported to Europe and America. *Hyoscyamus niger* is a native of the temperate Himalayas at an altitude of 6,000 to 10,000 feet and a good quality of the drug can also be grown in the plains of the Punjab. A number of species of *Mentha*, *Aconite* and *Juniper* grow all over the Himalayas; *Juniperus communis* occurs abundantly in some parts of Kashmir. *Valeriana indica* can be found in large quantities in Kashmir and Bhutan. A number of varieties of *Artemisia* grow in the Northern Himalayas and the mountain ranges of the North-Western Frontier and santonin-bearing *Artemisia brevifolia* grows abundantly in Kashmir and in the Kurram valley. A very good quality of *Podophyllum emodi* is met with in the higher shady temperate forests of the Himalayas from Sikkim to Kashmir at a height of 6,000 to 7,000 feet. The Forest Department has now taken up its cultivation in the Punjab, United Provinces and North-Western Frontier Province.

Besides these there are a number of pharmacopœial drugs which are widely used by the medical profession, but which do not naturally grow in this country. They thrive, however, when they are cultivated under proper conditions in suitable parts of the country. Examples of such drugs are numerous but a few of the important ones such as digitalis, ipecacuanha, eucalyptus, cinchona, jalap, etc., may be cited. They were introduced into India many years ago and are doing well. On account of the great demand for these drugs their production in this country would be of some economic importance, especially in view of the gradual extension of Western medicine among the masses. India possesses most wonderful variability so far as the temperature and general climatic conditions are concerned and as will be shown later every conceivable drug ranging from those growing in the hottest tropical and damp climates to those growing in dry, temperate and very cold climates can be grown and acclimatised in some part or other. From the geological point of view also every grade of soil from alluvial deposits to hard rocky formation and sandy deserts

is met with. Professor Greenish of the London School of Pharmacy rightly said, "India, owing to the remarkable variations she possesses of climate, altitude and soil, is in a position to produce successfully every variety of medicinal herb required by Europe".

It should be remembered, however, that the soil, the season and the gathering time are some of the important variable factors with plants and it can hardly be expected that the amount of active constituents would be constant under all conditions. In some cases the quality is good and constant, but in the majority of instances the percentage composition of the active principles has yet to be determined by careful methods of chemical and biological assay, to show that these remedies, growing in a state of nature, are as good in quality as those of the imported varieties. If they do not come up to the required standard, the best method of bringing them into general use by improving the quality of the active principles by suitable cultivation, in parts of the country where this can be done economically, has yet to be determined.

Secondly, a large number of plants grows in India which, though not exactly the same, have properties and actions similar to the imported and often expensive remedies, and would form excellent substitutes. Not infrequently it is some closely-allied species which is pharmacologically just as active. That many such plants do exist, there is very little doubt; but since no effort has been made to work out their medicinal properties on scientific lines, or to confirm the work already done, there appears to be a great deal of uncertainty about their action. Unless such work is done it can hardly be expected that they will be taken into use by the profession, in the place of more certain and tried remedies. Numerous examples come to one's mind but a few may be cited. *Colchicum luteum*, grows on the slopes of the western temperate Himalayas and would form an excellent substitute for the official *C. autumnale*. *Scilla indica* grows extensively on the sea-coast and on the drier hills of the lower Himalayas and the Salt Range and would make a good substitute for *S. maritima*. *Ferula narthex* from which a gum resin resembling asafœtida can be

obtained grows in Kashmir. The properties of *Picrasma quassioides* and *Gentiana Kurroo* resemble those of *Picrasma excelsa* and *Gentiana lutea* respectively of the British Pharmacopœia.

In both these groups there is an enormous field for research and development. If these drugs are investigated, their active ingredients recognised, their percentage composition determined, their action established and standardised, and pharmaceutical preparations manufactured, the economic benefit to the country will be immense.

VII

INDIA'S FOREIGN TRADE IN DRUGS:—The economic importance of the first proposition can only be fully appreciated by studying the position of the drug trade of India. A study of the figures of the total values of imports and exports during the last 25 years discloses some remarkable facts. Both the import and export trades have considerably increased during the last 20 years. Thus in the year 1908-09 the value of drugs exported from India amounted to Rs. 15.5 lacs against imports which amounted to Rs. 73.0 lacs. In the year 1928-29 the export and import values of drugs were respectively 42 lacs and 200 lacs. This shows the remarkable extent to which the trade has increased and at first sight this would appear to be a very satisfactory state of affairs. A closer scrutiny, however, reveals that the imports are proportionately very much larger than the exports. This means that while much raw material is going out of the country, very considerable quantities of refined preparations manufactured in foreign countries are coming into the Indian market. The position is not improving although the averages of imports and exports for the pre-War, War and post-War periods and another period of five years from 1924-25 to 1928-29 show a slight fall in imports and some rise in exports.

TABLE I

	Value of imports	Value of exports
	Rs.	Rs.
Pre-War average	94,10,289	18,17,835
War average	127,85,189	29,54,350
Post-War average	179,91,326	36,15,878
Average of last 5 years ...	166,40,196	37,19,870

If we now proceed a little further into details and carefully study the reason of the large excess of import over export, we are at once struck with the fact that most of the imported drugs are standardised pharmacopœial preparations such as galenicals and purified alkaloids, in many cases manufactured from the same drugs that have been exported ; besides these there is a large import of proprietary or patent preparations. A perusal of Table II shows that over 100.9 lacs worth of the former group under the heading of 'other sorts of drugs and medicines' and 42.8 lacs worth of the proprietary preparations were imported in 1928-29. The proprietary and patent medicines have exhibited a phenomenal increase during the last five years, *i.e.*, from about 25.0 lacs to 42.8 lacs. This shows the increasing extent to which the Indian market is being exploited by the manufacturers of these remedies. The figures showing pharmacopœial preparations and chemicals have risen from 87.8 lacs to 114.3 lacs in 1927-28 but showed a slight decrease to 100.9 lacs in 1928-29. The import drug trade, taken all round, shows a definite and marked increase. The other items of interest in this table are camphor, whose import is steadily on the increase, and the quinine salts, which have been showing some fluctuation but on the whole show an appreciable increase.

TABLE II

Drugs and Medicines (excluding Chemicals and Narcotics) imported in India during five years from 1924-25 to 1928-29

Name of Drugs Imported	Quantity					Value in Rupees				
	1924-25	1925-26	1926-27	1927-28	1928-29	1924-25	1925-26	1926-27	1927-28	1928-29
Aloes — cwts.	1,961	547	2,375	1,004	...	37,218	12,394	67,792	25,543	Included in Drugs of other sorts.
Asafœtida — cwts.	6,335	2,719	3,947	3,236	3,612	3,77,005	1,86,642	1,57,412	1,14,532	2,08,343
Camphor — lbs.	2,07,150	9,93,007	14,01,695	13,73,701	16,12,356	23,02,563	21,47,341	27,96,850	25,93,177	27,79,631
Cocaine — ozs.	747	1,334	551	1,157	1,259	11,082	20,737	11,636	17,622	18,476
Cod Liver Oil — lbs.	...	84,827	66,857	75,638	90,602	...	1,50,097	1,22,733	99,435	1,30,796
Morphia & Preparations of Opium — ozs.	640	687	1,090	1,111	1,800	47,447	64,312	1,05,262	1,34,919	1,36,564
Quinine and Salts — lbs.	1,07,523	1,30,459	1,19,567	1,13,637	1,33,795	28,08,734	30,96,160	26,25,239	23,42,186	24,47,075
Sarsaparilla and preparations	...	...	...	...	...	40,650	43,185	24,321	37,307	...
Storax	1,11,762	1,30,753	94,455	1,10,899	...	31,566	34,297	28,974	29,775	...
Saccharine ...	...	...	...	...	29,612	...	...	...	...	1,12,652
Proprietary and Patent Medicines	...	...	...	...	...	25,06,303	24,15,232	27,29,228	29,26,782	42,83,667
Other sorts of Drugs and Medicines	...	...	...	...	...	87,88,830	91,30,150	103,03,590	114,38,753	100,95,756
Total ...	...	...	...	...	...	169,64,005	173,11,020	190,02,128	198,28,068	202,12,950

N.B.—1 lac=100,000.

TABLE III

Drugs and Medicines (excluding Chemicals and Narcotics) exported from India during five years from 1924-25 to 1928-29

Name of Drugs Exported	Quantity					Value in Rupees				
	1924-25	1925-26	1926-27	1927-28	1928-29	1924-25	1925-26	1926-27	1927-28	1928-29
Asafœtida — cwts.	9	54	65	...	...	1,783	2,953	4,219	735	...
Camphor — lbs.	1,382	16	...	100	...	1,425	80	...	175	...
Cinchona bark — lbs.	5,59,592	4,86,187	80,691	1,73,529	1,38,104	2,12,712	2,45,398	43,460	90,002	78,024
Galangal — cwts.	188	519	536	633	575	5,157	12,662	11,915	14,096	12,850
Nux Vomica — cwts.	30,258	44,079	54,347	50,702	43,212	2,27,836	2,96,091	3,48,653	3,27,858	3,03,208
Senna — cwts.	47,544	44,995	49,117	52,814	46,995	10,74,678	8,93,052	8,93,052	9,48,812	8,60,208
Other sorts of Drugs	...	...	...	...	...	19,83,384	2,22,711	24,03,426	20,11,689	29,06,142
Total Drugs and Medicines	...	...	...	...	...	35,87,425	36,77,347	37,10,220	34,53,367	41,60,988
Tea dust for manufacture of Caffeine — lbs.	32,39,907	30,00,969	15,91,330	41,14,638	...	4,90,644	5,50,983	2,63,810	4,41,671	...

N.B.—1 lac=100,000.

The most outstanding figures in the export Table III are those under the heading 'Total drugs and medicines' which show a persistent increase from 35.8 lacs to 41.6 lacs during the last five years. This would appear to be promising but for the much larger increase in value of prepared drugs imported. A perusal of Table III also indicates that the export of cinchona bark has been showing a decrease lately. The depression in the export of the bark is rather a hopeful sign. The cinchona requirements of India are so large that the local production of the drug cannot keep pace with the demand. On the other hand, large quantities of quinine and quinine salts have to be imported annually into the country and the export of cinchona bark cannot but be regarded as harmful from an economic point of view.

A list of different drugs exported under the heads of 'Other sorts of drugs and medicines', spices, oil seeds, narcotics, etc., in the Sea-borne Trade Returns of India is given below. The list does not pretend to be exhaustive but furnishes only the most important drugs included under these groups.

Aconite napellus, Alstonia scholaris, Atropa belladonna, Althæa officinalis, Arachis hypogæa, Areca catechu, Anogeissus latifolia, Berberis aristata, Butea frondosa, Catechu nigrum, Swertia chirata, Cannabis indica, Cocculus indicus, Cambogia indica, Croton tiglium, Cuminum fructus, Cæsalpinia bonducella, Cassia fistula, Ephedra vulgaris, Datura fastuosa, Hemidesmus indica, Ipomœa hederacea, Terminalia chebula, Podophyllum indica, Papaver somniferum, Piper longum, Piper nigrum, Picrorhiza kurrooa, Ricinus communis, Saussurea lappa, Santalum album, Urginea indica, Zingiber officinale.

It will be seen from the list given above that all these drugs in crude forms are annually exported from India to foreign countries at a nominal price, are utilised in various medical and allied industries and a portion of them, at any rate, is returned to India in the form of expensive preparations. The finished products naturally fetch considerably higher prices and hence the increase in the export revenues only shows to what an extent the Indian raw materials are being utilised by

the drug manufacturers of other countries to their benefit and perhaps to the economic loss of India.

If more of the crude materials were utilised in India in the way in which this is being done in other countries, it will not only save the drain of India's gold but the development of this industry will open up a new avenue of employment for millions of people.

VIII

THE DRUGS USED IN THE INDIGENOUS MEDICINE:—The second proposition of popularising and introducing new drugs to Western medicine is a more difficult one. Since the period of decay and recompilation, many of the effective remedies have been lost and a number of uncertain ones have come in. The result is that in the indigenous systems at the present time almost every plant and shrub growing in the country has ascribed to it some medicinal virtue. These beliefs, in some cases, originate from the teachings of the ancient commentators and are based on clinical data, but in others have no foundation whatever. Their introduction was empirical and often a drug was used simply because a single case happened to have derived some benefit from it. In this way remedies have multiplied without proof but by belief, and, as they hail from all parts of India, no one seems to have a correct notion about their uses and properties. The employment of a large number of them would thus appear, as in Western medicine, to have been based on empirical evidence handed down from generation to generation. A thorough and complete research into all these drugs would constitute the lifelong work of innumerable chemists, pharmacologists and physicians. For practical purposes the method adopted has been to make use of the experience of Kavirajes, Hakims and others, and to take up those drugs which have a great local reputation for investigation before touching the less reputed remedies. Besides, many of these drugs have been clinically tried by some of the medical men practising Western medicine, who have expressed their opinion regarding their efficacy; this has also been helpful in the selection of drugs to be investigated.

Dr. Koman of Madras some years ago made a clinical study of the medicinal properties of a large number of the indigenous drugs, and it will not be out of place to mention his conclusions here. According to him the following drugs are of value when tried on patients, but he recommends that further research on scientific lines is necessary before they can be safely recommended for universal adoption:—

Hydnocarpus wightiana for leprosy; *Calycopteris floribunda* (*Chempullani*) as anthelmintic and laxative, it contains a neutral principle which gives all the reactions of santonin; *Eclipta prostata* (*Babri*) as a cholagogue; *Bœrhaavia diffusa* (*Punarnava*) as a diuretic; *Holarrhena antidysenterica* (*Kurchi*) and *Bombax malabaricum* (*Simul*) in dysentery; *Alstonia scholaris* (*Chhatim*) which contains the alkaloid *ditamine* as antiperiodic in malaria; *Sida cordifolia* (*Bala*) in diseases of the nervous system, neuritis and paralysis.

There is also a number of other plants which have the reputation of being efficacious in certain diseases and which might with advantage be investigated. Examples of these are: *Adhaloda vasica* (*Bakas*) as an expectorant and anti-asthmatic; *Melia azadirachta* (*Nim*) as an antiperiodic; *Saraca indica* (*Asoka*) in menorrhagia; *Terminalia arjuna* (*arjuna*) as a cardiac tonic; *Balsamodendron mukul* (*Gugal*) as an anti-rheumatic and nervous tonic; *Butea frondosa* as an anthelmintic for round worms; *Peganum harmala* (*Harmal* or *Asband*) as anti-asthmatic and febrifuge; *Saussurea lappa* (*Kut*) as an aphrodisiac and cardiac stimulant; *Ægle marmelos* (*Bael*), *Plantago ovata* (*Ispaghula*) and *Ailanthus malabarica* (*Ood*) in chronic diarrhœa and dysentery; *Herpestis monniera* (*Brahmi* or *Safed Chamni*) in hysteria and epilepsy; the seeds of *Psoralea corylifolia* (*babchi*) in leucoderma.

Not infrequently we ourselves carry out clinical trials before taking up investigation of a drug on scientific lines. A large number of drugs are referred to the Department of Pharmacology by medical practitioners and others for opinion and often requests are made that, as the particular drug sent is useful, its investigation may be taken up at once. To avoid

wasting time and money, we try it on a series of cases carefully following the instructions given. If the results obtained after such trials are satisfactory the drug is handed over to the chemists for analysis ; if not, it is discarded.

IX

IDENTIFICATION OF INDIGENOUS HERBS :—The drugs are many in number and varied in character, and the process of inquiry is long, tedious and laborious. In addition to these there are other difficulties which confront the investigator and have to be surmounted. Many of the remedies mentioned in the old books baffle and defy recognition and identification, and one cannot be certain from the description whether the specimens obtained are of the particular drug described.

The identification of drugs will remain a prime difficulty until certain prominent characteristics of each drug become established. No amount of verbal description of these drugs as given in the books will enable the botanists to identify some plants and parts which even in themselves do not invariably present the same characteristics. The result is that there has been a good deal of confusion; many drugs are being sold under various names, different drugs under the same name, and even the learned Kavirajes and Hakims cannot say with certainty which is the authentic specimen meant in the old texts. We have often come across entirely different herbs being sold in different provinces under exactly the same name. A very careful enquiry has often to be made in which considerable help can be obtained from the local names given to the herbs. There are professional castes who deal with the medicinal herbs, who have considerable knowledge of these plants, and who can throw much light where all other measures fail. In Central and Upper India *Musheras,* in Bengal people of such low castes as *Maules, Bediyas, Bagdis, Kaibartas, Pods, Chandals, Kaoras,* and *Karangas* and on the Bombay side *Chandras, Bhils* and *Gamtas,* know a great deal about the herbs used in indigenous medicine and described in old books.

X

A Retrospect of Results Achieved:—The investigation of drugs used in indigenous medicine was started nearly a decade ago and comparatively speaking much has been accomplished during this short space of time. A number of important medicinal plants prescribed by the Kavirajes, Hakims, etc., have been carefully investigated from every point of view. Their chemical composition has been determined, the pharmacological action of the active principles worked out by animal experimentation, and finally suitable preparations made from the drugs have been tested on patients in the hospital. It is only by such a thorough enquiry that the real merits of these drugs can be proved and a demand created for them not only in India but in other parts of the world. This laborious work has brought into prominence the merits and qualities of certain drugs and it has been shown that they may prove to be very valuable additions to the present armamentarium of the medical man to relieve the sufferings of humanity, if brought into general use. Such drugs unfortunately are not many. A large number of those examined showed a certain amount of activity but were not found to be superior to the drugs already possessed by the pharmacopœias; in fact, they were not even nearly as efficacious. A third group of these drugs consists of those remedies which although largely used in indigenous medicine were found to have little or no activity whatever. Many drugs of questionable value and doubtful utility crept into the indigenous systems during the period of decay. We hope to discuss those drugs on which investigation has been completed later, but it will not be possible to enter into the details of all the aspects of this work. For this, reference should be made to the original papers published from time to time.

Apart from establishing the value of many useful remedies there is another aspect of this work which should not be neglected in our survey. At the present time most of the drugs used in indigenous medicine are supposed to be

specifics for some particular diseases and lay people will wax eloquent in their descriptions of the wonderful cures said to have been produced by some of these remedies. Glowing statements of this nature, supported by insufficient evidence, have also appeared in medical journals. This has done a great deal of harm to their reputation, and distinguished pharmacologists of Europe and America are beginning to be pessimistic and to doubt if there is really anything of much value in the vast array of the materia medica of the indigenous systems of medicine, and are inclined to take the view that an investigation into the properties of these drugs is not likely to lead to any material results. In this way the reputation of these remedies has grievously suffered in Western medicine, the good ones being indiscriminately classed with the bad. Only systematic research of this kind can establish the value of the useful ones. Thereby the chaos that exists in these drugs will be removed and the true teachings of the Ayurvedic and Tibbi medicine will become available to all the world.

XI

How to effect Economy and bring the Treatment within the means of the Masses:—The third and the last proposition relates to the devising of expedients for effecting economy, so that these remedies may reach the masses. This is only possible if the price of the drugs can be considerably reduced; for, in a poor country like India, there are millions of people who cannot afford any kind of treatment, whether cheap or expensive, and have consequently to depend upon charitable medical relief institutions. The cost of drugs is so heavy that most of these institutions, which have only a limited annual budget for drugs, are not able to cope with the demand for such common and essential drugs as quinine, castor oil, magnesia, etc., to say nothing of the expensive medicines which are sometimes necessary and even indispensable.

The only way in which drugs can be cheapened and brought within the means of the masses is to utilise the local

resources and substitute the indigenous products for the more expensive imported preparations of Western medicine. This can be done by encouraging the production, collection and manufacture of the local materia medica by preparing pharmaceutical preparations in a systematic manner. By local production and substitution of equally potent drugs of Indian origin for the imported drugs, the cost of treatment can be considerably reduced. We have already made reference to some of these remedies and the possibilities of their development. Their active principles can be isolated, and standardised preparations such as tinctures, extracts, powders, etc., can be prepared without difficulty with inexpensive apparatus. If this is done on a large scale, it will be possible not only to effect saving in the seaborne freight but in many other charges. As we have already pointed out crude drugs are exported from India at a very low price and are re-imported in many cases in the form of refined standardised preparations at many times their original price. Carriage and freight charges to and from the ports of import and export have to be considered at both ends. The actual seaborne freight may not be much but the insurance charges, agents' commissions, export and import duties, custom and excise duties on alcoholic preparations greatly increase the price to an extent far beyond the means of the ordinary ryot in India, as these charges eventually fall on the consumer. Besides that, owing to cheapness of labour in this country enormous reduction in the cost of manufacture could in all probability be effected. A perusal of the export Table III shows that nearly 4.1 million pounds of tea-dust is annually exported to Europe and America at a nominal price whereas caffeine manufactured from it, amounting to 82,200 pounds would be worth 657,600 rupees. Nux vomica seeds to the extent of 50,000 cwt. are exported annually at a price of Rs. 32,000, whereas the alkaloid strychnine and pharmacopœial galenical preparations made from it would bring Rs. 112,000. Belladonna, stramonium, castor oil seeds and chaulmoogra seeds are taken thousands of miles away for manufacturing refined products.

Many other examples can be cited but it is not necessary to discuss them in detail here.

There are, however, difficulties in connection with the collection and distribution of crude drugs from the point of view of the Indian manufacturers. The chief difficulty is that in many cases the total value of the requirements is so small that larger and more reliable firms are not interested in their production. Even when the requirements are large there are so many middlemen to be reckoned with that the local market price becomes very much inflated. As a matter of fact indigenous materials of better qualities have been known to be re-imported at a cheaper rate than those obtained locally. It would appear that in many cases the best qualities are exported and only inferior and adulterated material retained for local consumption. To take nux vomica as an example, the collectors of the seeds in Orissa receive only Rs. 1-4-0 per *maund* of 105 lbs. delivered washed and dried at the buyer's godown. These very seeds were sold in Calcutta at from Rs. 4/- to 6/- per maund with the result that strychnine factories have sometimes had to be temporarily closed down, as with this price it was impossible to compete with the European manufacturers.

In spite of this, during recent years some progress has been made in the direction of manufacture of pharmacopœial preparations and refined chemicals for medicinal purposes from the crude products of this country. A number of firms have been established and caffeine is being manufactured from tea-dust, strychnine from nux vomica seeds and ephedrine from the Indian species of ephedra. The output of these products is, however, at present very small considering the size of the country and its large population. It is not enough to supply even a fraction of the requirements of the people to say nothing of exporting such preparations to other countries. Unless considerably more attention is paid towards the development of this branch of industry, it will not be possible to cheapen the medicaments sufficiently to bring them within the means of the large masses of this country. Refined products are not manufactured on a large enough scale at

the present time. There is no reason against it, provided research on the drugs is properly organised. The Medical Store Depots, at the instance of the Indigenous Drugs Committee many years ago, made pharmaceutical preparations of the well-known official and non-official remedies which are indigenous to this country and issued them for trial to the dispensaries and hospitals with excellent results. Some of the local firms in Calcutta have also taken up the manufacture of galenicals such as tinctures and extracts, not only from the pharmacopœial drugs, but also from the indigenous medicines. There is a very large demand for the former class, but as regards the latter group the pharmacological action of many of these remedies has not yet been properly investigated and their use is limited amongst the profession. The whole of this subject should be looked at from a scientific as well as from a business point of view. If the capitalists come forward and help in enterprises of this nature they will find very large margins of profit.

XII

DEVELOPMENT OF ALLIED INDUSTRIES:—*Solvents*. The manufacture of refined chemicals, alkaloids, etc., for medicinal use can also be easily undertaken by the existing manufacturing firms and as a matter of fact this is now being done on a small scale. Such concerns are already doing well but the question of solvents which have to be extensively employed is a difficult one. With the exception of alcohol most of the solvents such as chloroform, ether, benzene, petroleum ether, etc., have to be imported from other countries and a high price has to be paid for them. Even in the case of alcohol although the actual cost of production of rectified spirit at present is about Rs. 2-4-0 per imperial gallon, the excise duty charged on it is Rs. 37-8-0, *i.e.*, nearly 16 times the cost of manufacture of alcohol. It is true that for medicinal purposes a special concession rate of Rs. 5/- per proof gallon (bulk Rs. 7-4-0) is allowed to certain drug manufacturers with bonded stores, but in spite of this the price of

spirituous preparations is beyond the means of the poor masses. Unless an appreciable reduction is made in the price of the alcohol used for medicinal purposes, it will be impossible to bring down the price of the preparations to the economic level of the Indian ryot.

Benzene and petroleum are two solvents which come next in importance to alcohol. Both of them could be easily manufactured from raw materials available, at a very cheap price. Benzene could be manufactured from coal in the coal-fields. It is being manufactured by one or two firms of coke oven owners, but whereas the cost in England is one shilling per gallon, in India it is being sold at Rs. 1-10-0 per gallon plus a duty of 6 annas; only a limited supply, not nearly sufficient to meet the demand, is available even at this high price. Most of the bye-products in the production of coke are being allowed to go waste. The other solvents such as acetone and glycerine could also be easily manufactured. Acetone is prepared from wood shavings and sawdust. Enormous quantities of raw material are available as about one-ninth of the total area of this vast country is covered with forests. In spite of this there is only one acetone factory in the whole of India at the present time and that also has come into being at the initiation of the Government. Enormous quantities of glycerine are being thrown away in the form of soap wash lye from soap factories in India, which could be recovered. There is, however, no firm of soap manufacturers in India on a sufficiently large scale, to be able economically to recover glycerine to compete with the prices at which the imported product is sold. Over 90 per cent. of the machinery required for pharmaceutical factories is at present being imported from America and Europe. Pharmaceutical appliances such as percolators, tincture presses, vacuum stills, emulsifiers, tablet makers, pill machines, autoclaves, etc., are all imported from foreign countries. With a little organisation all this could be easily done in India and at much cheaper prices. There is more need for private enterprise in this direction. The development of various industries in connection with drug manufacture in itself has a great future.

XIII

USE OF CRUDE DRUGS :—Secondly, by using crude drugs and preparations the cost of treatment could be considerably reduced. The utility of the Western medicine to the masses in India has been limited by reason of its costliness. Its further progress, in spite of all efforts that are being made, is being hampered for economic reasons; because of the poor returns of agriculture and the small wage-earning capacity of the people, they can afford only the cheapest remedies and treatment. As long as the economic conditions of India remain as they are at the present time, so long will the average villager demand, and very naturally too, something within his means, *i.e.*, medical advice costing a few annas and the treatment costing less. The separation and purifying of the active principles from drugs or making standardised preparations naturally involve considerable additional expense. The result is that a bottle of medicine lasting only a few days costs twelve annas to two rupees which is far beyond the means of an average Indian. A great many of the maladies of everyday life for which drugs are used are of a minor nature. Many of the crude drugs available in the bazars, if intelligently used, are very nearly as efficacious as the refined preparations, and substitution of such cheap products is bound to bring down the cost of treatment to a minimum. Crude vegetable purgatives are often as effective as the elaborated products. Economy can also be effected in many of the most widely-used drugs in this country and many examples can be cited. For many years quinine was separated from the total alkaloids of cinchona bark under the impression that it was the only effective alkaloid against malarial infections. The isolation and refining of this alkaloid naturally made it more expensive. The researches of Acton, McGilchrist and Fletcher have conclusively shown that the other three of the main alkaloids occurring in the bark are also effective against this widespread disease in the tropics. The total alkaloids of the bark in the form of cinchona febrifuge were, therefore, extensively tried and after careful observations, have been

found to be quite as effective as the purified quinine itself. During the War, the price of quinine went up to Rs. 55 per pound, and although it came down to Rs. 24 per lb. in 1924 and Rs. 18 per lb. in 1926, and is still keeping at that level, it is still too high for the economic condition of the masses in this country. The result is that most of the hospitals and dispensaries in the mofussil whose annual budgets are not very generous or extensive can only afford a limited quantity of this important and essential drug, which is quite inadequate to meet the demand. In order to supply quinine the supply of other often important drugs has to be curtailed. The substitution of the total crude alkaloids (cinchona febrifuge) in the place of purified quinine will not only effect a great saving (large quantities of quinine salts are being imported) but will help to bring the treatment of malaria within the means of the poor and thus alleviate the sufferings caused by this most universal and incapacitating of all diseases in the tropics. We have dealt with this question more fully under cinchona. The total alkaloids of ipecacuanha have also been shown to be nearly as effective against amœbiasis, which is also very prevalent in this country, as pure emetine. Then again in the case of *H. antidysenterica* it has been found that the total alkaloids and the galenical preparations made from the bark are better than purified conessine. The tincture made from *Ephedra vulgaris,* introduced by the author, is just as effective in the treatment of asthma, cardiac failure, etc., as the very expensive alkaloid ephedrine. Such examples could be multiplied. It should be possible to prepare tablets from many of the indigenous drugs which could be sold at a very cheap price. Attention to this subject is of great importance to this country, because economy and low cost of advice and treatment are of paramount importance to any plan of medical relief that can hope to succeed in this country.

XIV

CULTIVATION OF MEDICINAL PLANTS:—*Utilisation of Forest Resources.*—Lastly we will touch on the important

question of the cultivation of drugs on a commercial scale in this country. India is a veritable emporium of medicinal plants; nearly three-fourths of the drugs mentioned in the British and other pharmacopœias grow here in a state of nature. Not only has the country great resources so far as the medicinal plants are concerned, but many kinds of perfumes and spices which are known all over the world abound in it. India possesses climatic conditions varying from the torrid to the frigid zone. It embraces vast tracts of tropical plains, temperate hills and valleys, irrigated soil, moist and dry climates and cheap labour. It has in fact been described as an epitome of climates, seasons and soils of the British Empire. It is, therefore, possible that the drugs which do not naturally grow within her bounds could be easily made to do so. Acclimatisation is possible to a large extent with almost any plant and there are many instances where plants, indigenous in one country and originally marketed from one country only, have been introduced into the other countries and established on a very firm foundation.

So far reliance has been almost entirely placed on the natural resources of the country and the drugs growing in a state of nature alone have been chiefly collected and utilised. The fact should, however, be appreciated that although the country embraces every climate and situation the great obstacle to the development of forest drug resources has always been the question of transport. These forests in many instances are situated hundreds of miles away from the railheads and the cost of transport would be prohibitive. The transport facilities have, however, been greatly improved during recent years and the advent of motor transport has brought distant places within reach. The Forest Department, we have no doubt, leaves no stone unturned to utilise all their resources to the fullest extent and already there are signs of activity. With the setting up of an Imperial Council of Agriculture, and the large research grants it has at its disposal, the subject of cultivation of medicinal plants, it is hoped, will also receive the attention it deserves, and the drug resources of the country will be developed to their full extent.

Drug Cultivation:—Important medicinal plants such as digitalis, ipecacuanha, cinchona, jalap, etc., are already being grown, and there is no reason why the country should not grow every drug to supply her own needs, if not for export. It has been shown that already a large export trade is in existence in some of the pharmacopœial drugs. Material collected at random, however, is very often not up to the standard quality and the trade has suffered many vicissitudes for this reason. The variations in the quality of wild grown drugs is a very serious drawback to their employment for therapeutic purposes. The result is that India imports not only large quantities of drug preparations and purified chemicals, but also crude drugs to the extent of many millions of rupees annually. Vast tracts of land are lying waste at present in the country which if utilised for the cultivation of drugs will not only enrich those concerned in the enterprise but will give the people of the soil drugs at a reasonable price. The great advantage accruing from a systematic cultivation of drugs is that a regular supply of genuine drugs of a standard quality can be assured. The total area of land under cultivation of various crops in India is 324 millions of acres of which the non-food crops occupy about 65 million acres, *i.e.*, roughly 24 per cent. of the total cultivated area. Of the non-food crops the drugs and narcotics occupy about 2.6 million acres, *i.e.*, 0.8 per cent. of the total area of land under cultivation. The Government plantations for the cultivation of cinchona though nominally nearly 15,000 acres actually occupy less than 6,000 acres. Narcotics, such as hemp, tobacco, opium, etc., occupy the major portion of the remaining land. It would appear from this that, with the exception of cinchona and a few small experimental farms for other drugs in places like Saharanpur in the United Provinces, and Coimbatore and Ootacamund in South India, very little is being done at present to foster the cultivation of medicinal plants. This fact is indeed deplorable. The idea of cultivation of medicinal plants in botanical gardens under experts is not a new one. As early as the 16th and 17th centuries botanical gardens for the cultivation of drug plants existed and great interest was

exhibited in their maintenance by the ruling chiefs and princes. In 1560, there were fifty such gardens in Italy. The botanical garden of Pisa and the drug garden at Padua, which are said to have been started somewhere in the year 1546, still exist. The drug emporium at Leiden in Holland dates from 1575. In India, botanical gardens for cultivation of drugs were reared under highly qualified specialists during the Buddhistic régime. There is evidence to show that Asoka the Great had a special fancy in this direction and subscribed large grants from the state funds towards their development. In this generation, the utility of drug gardens is also fully appreciated by the people, but the chief reason which seems to have kept this important scheme in the background is that grave doubts have been expressed in many quarters regarding the financial success of medicinal plant cultivation in this country. Although the consumption of vegetable drugs has decreased during the last 50 years and the synthetic preparations are fast replacing the drugs elaborated in Nature's laboratories, the former are still our mainstay. During the past few years, the production of vegetable drugs has actually increased in Germany, a country in which the chemical industries are perhaps more developed than in any other country in the world. Furthermore, in countries like Germany and Belgium medicinal plants and essential-oil gardens have proved a great success. The state in France is taking a great deal of interest in growing drugs on a large scale and in the United States of America medicinal herbs are being cultivated on an industrial scale and the cultivators are reaping a rich harvest and making large profits. More interest created in this direction will be greatly to the advantage of all concerned. In the United States of America there is a Bureau of Plant Industry attached to the Botanical Survey Branch of the Department of Agriculture where all questions relating to the development of drug cultivation are considered. This Bureau sends its agricultural experts to various parts of the world to investigate the climate, soil and environments suitable for the growth of a particular plant. There are also agricultural farms for plant industry in Germany and Belgium, and

in many places cultivation of drugs has been combined with cultivation of plants for the distillation of essential oils and perfumes. Recently the commonwealth of Soviet Russia and the Hungarian Government have been showing a great deal of interest in the subject and are establishing bureaux for carrying on drug trade. All these departments are doing splendid work in their respective countries.

If such a system is introduced into India, it will indeed work wonders. Establishment of a drug emporium was suggested many years ago but has not yet materialised. It is true that experimental drug farms have been started on a small scale in places like Saharanpur, Mungpoo, etc., but their sphere of activities has so far been very limited. A start in this direction has been made recently under the auspices of the Forest Research Institute, Dehra Dun. The Minor Forest Products Department of this Institute is trying drug cultivation on an experimental scale and already encouraging results have been attained in many respects. As early as 1913 Mr. Puran Singh, Chemist of the Forest Research Institute, Dehra Dun, made some very valuable suggestions to encourage the cultivation of medicinal plants in India. He suggested that the first thing to do was to make a complete survey of the extent of the inland trade in the medicinal drugs mentioned in that monumental work—*A Dictionary of the Economic Products of India*—as well as those found growing wild in the Indian forests, so that the figures of annual consumption of different provinces could be ascertained. Notes should also be made of the sources from which those products are obtained at the present time, and of the extent of the present demand and the possibility of its expansion. Only after completion of such a survey would it be possible to make an organised attempt to preserve forest areas where the most important drugs grow, to study the best methods of cultivation and, if need be, to extend the cultivation. Many of the drugs concern the Forest Department, but the Department of Agriculture would also be interested in a very large number of them. The co-operation of expert botanists, pharmaceutical chemists and pharmacologists is essential for the success of such a scheme. They can not only

advise regarding the locality where particular drugs can be successfully cultivated, but also the time suitable for cultivation, collection, etc., to get the maximum activity and yield of their active principles. They can devise methods for improving the contents of the active principle where they are deficient. A detailed study of the chemistry of the Indian medicinal plants will not only contribute new facts to the science of drug chemistry, but such a study is bound to bring them to the notice of the medical profession in India and elsewhere. Work done on *Artemisia maritima* illustrates how the artificial cultivation and acclimatisation of a drug can be effected, and how improvement in the contents of active principles can be brought about by scientific cultivation. *Artemisia* containing santonin was believed to grow only in Russian Turkestan, but during the War, when that supply was cut off, Van Laren by scientifically studying the nature and habitat of the plant successfully grew *Artemisia cina* in Holland, which gave a fairly high yield of active principles. Then again *Artemisia* growing in a state of nature in the Russian Turkestan had a santonin content of 1.5 to 2.6 per cent., but by proper cultivation the amount of active principles could be increased from 2.6 to 3.6 per cent. Investigations on these lines would undoubtedly open up a vast field of research to the chemists and pharmacologists, the scientific and economic importance of which is difficult to over-rate. It goes without saying that scientific research in the modern world is the basis of economic improvement. Large co-operative and business agencies are developing their research departments at very large expense and consider it a profitable investment. Systematic research in this direction would not only be profitable to the drug growers but would also benefit the private capitalists by enabling them to open up new and hitherto untrodden fields of enterprise in this country. With the development of one industry, other industries will flourish side by side and the whole nation will be enabled to reap their benefits.

XV

PROPRIETARY MEDICINES :—The problem of effecting economy might also be tackled from another side, that is by avoiding as far as possible the use of proprietary and patent medicines. A perusal of the import table will show that drugs belonging to this class are being annually imported into the country to the extent of 42.8 lacs of rupees and the figures are going up every year. The tendency on the part of the medical profession in India to use proprietary drugs in preference to the pharmacopœial drugs is to be greatly deplored. It is a painful thing to see that almost every prescription sent to the dispensing chemists in Calcutta contains some proprietary medicine or other. These of course greatly increase the expense to the patient and this fact unfortunately is not often realised by the practitioners. We have always held that if the combined drugs of the British and United States Pharmacopœias are not going to give relief to the patient, proprietary remedies whose composition and action is in many cases unknown will certainly not improve matters. While it cannot be denied that some of the proprietary remedies are very effective therapeutic agents, a large number of them have not even the efficiency of cheaper and more easily available drugs, and some have been proved to be not only entirely useless but even harmful. This widespred use of proprietary medicines cannot be attributed to anything but lack of interest on the part of medical practitioners in the science of pharmacology. If they paid a little more attention to the rational rather than empirical use of drugs, they would not be so easily deceived. They would not be so ready to believe the preposterous claims put forward in the drug notices and circulars sent to them by the manufacturers who advertise on a lavish scale, putting forward claims which cannot be substantiated, not only in the lay papers but also in some of the medical journals in this country. It is a matter for deep regret that medical journals should lend themselves to the publication of such notices.

XVI

ADULTERATION OF DRUGS :—From very early times adulteration of drugs was very severely dealt with in India. In the Buddhistic period anti-adulteration laws were drawn up on the lines of strictest severity and even the slightest carelessness on the part of the physician was vigorously dealt with. The dictum laid down was that 'all physicians who treat their patients wrongly shall pay a fine'. Unfortunately things were changed considerably with the decline of the Ayurvedic medicine. Partly on account of ignorance and partly because of deliberate intention on the part of dealers, adulteration of drugs has been practised for many centuries. Adulteration and substitution of one drug for another was so rife in the case of the indigenous drugs that the faith of the people of India became weakened in the products of their own country. Outside India, drugs of Indian origin are at the present time regarded with suspicion and considered worthless and unreliable on this score alone. *Cannabis indica* has lost a considerable portion of the reputation it once had in European practice on account of the fact that it is not of the same standard of quality as it was in former years. Similarly the bark of *H. antidysenterica* (*Kurchi*) lost its undoubted position as a specific in dysentery through the substitution of worthless barks; the aconites were equally unreliable. Even in the domain of the finished products considerable adulteration occurs. Nostrums and quackery are rampant to such an extent that people are duped every day. Many of the tinctures and spirits are below strength and this factor has brought the Indian manufacturers to a very low position and has had a damaging effect on India's export trade. The evidence before the Drugs Enquiry Committee left no room for doubt that, in regard to adulteration, deterioration or tampering with the quality or strength of drugs, very little distinction could be made between imported and locally manufactured medicinal preparations. This evidence was not only from medical men who tried the drugs clinically but was also based on actual analysis of the drugs

by such highly placed authorities as Chemical Examiners, Public Analysts, Officers in charge of Custom and Excise laboratories, etc. Having regard to the seriousness and far-reaching character of the problem the Committee also collected a large number of samples of drugs at random from the different provinces of India and subjected them to a careful analysis under the supervision of experts. The results confirmed the views of the witnesses in all their different aspects and reinforced the impressions generally prevalent. Not only is there adulteration, but many of the firms sell packages which are considerably under weight. The traffic in such drugs is extensive and indiscriminate. Unless and until this practice of adulteration and substitution is stopped the trade in Indian drugs and the preparations made from them will not improve in and outside India, and the use of indigenous products in the treatment of diseases will not be successful. The fact, though well-known, should be emphasised that economy cannot succeed at the cost of efficiency.

References :—

(1) Dey, K. L., 1896, *Indigenous Drugs of India* ; (2) Brown, 1920, *Arabian Medicine*; (3) Chopra and Ghosh, 1923, *Ind. Med. Gaz.*, Vol. LVIII, March; (4) Koman, 1924, *Report of the Indigenous Drugs Committee*, Madras; (5) Johnston Saint, 1925, Address on "Antiquity of Indian Medicine" the Wellcome Bureau of Scientific Research; (6) Chopra, R. N., 1927, *Trans. Far East. Ass. Trop. Med.*, VII. Congress, Vol. III, December; (7) Chopra, R. N., 1927, Presidential address, *Med. and Vet. Sec. Ind. Sci. Congress*, XIV Session; *Ind. Med. Gaz.*, Vol. LXII, March; (8) *Sea-borne Trade Statistics of British India*, 1927-29; (9) Ghosh, S., 1929, *Ind. Med. Gaz.*, Vol. LXIV; (10) Drugs Enquiry Committee, 1931, Report. Govt. India publication.

PART II

THE POTENTIAL DRUG RESOURCES OF INDIA

PHARMACOPŒIAL AND ALLIED DRUGS

The drug resources of India are vast and inexhaustible and it can be said without exaggeration that India could supply the whole of the civilised world with medicinal herbs. Leaving aside for the moment the drugs used in the indigenous systems of medicine, whose therapeutic value has been investigated in the majority of cases on scientific lines, most of the drugs of established therapeutic value used in the pharmacopœias of different countries grow in great abundance and often in a state of nature in many parts of India. Those which are not indigenous can often be grown in many parts. A list of such drugs is given below:—

List of Pharmacopœial Drugs or their Substitutes Growing in India

1. *Acacia arabica* .. ... (Acacia bark).
   Indian substitute—*Acacia indica.*
2. *Aconitum napellus* ... .. (Aconite root).
3. *Ægle marmelos* ... ... (Belæ fructus).
4. *Aloe chinensis* ... . (Aloes).
   ,, *perryi* and other species.
   Indian substitute—*Aloe indica.*
5. *Alstonia scholaris* & *A. constricta.* ... (Alstonia or Dita bark).
6. *Amygdala amara* ... ... (Amygdala).
   Indian substitute—
   Amygdala communis.
7. *Anacyclus pyrethrum* ... ... (Pyrethrum radix).
8. *Arachis hypogæa* ... ... (Arachis).
9. *Aristolochia serpentaria* and
   A. reticulata ... ... (Serpentary rhizome).
   Indian substitute—
   Aristolochia indica.
10. *Artemisia maritima* ... ... (Santonin).
11. *Astragalus gummifer* ... ... (Tragacanth).
    Indian substitute—
    A. heratensis and
    A. strobiliferus.

12. *Atropa belladonna* ... ... (Belladonna).
13. *Balsamodendron myrrha* and other species .. .. (Myrrha).
14. *Brassica nigra* ... ... (Mustard).
    ,, *campestris.*
    ,, *juncea.*
15. *Butea frondosa* ... ... (Butea gum or Bengal Kino).
16. *Camellia thea* and *Coffea arabica* ... (Tea and coffee plants from which the B. P. drug, caffeine is derived).
17. *Cannabis sativa* (or *indica*) ... (Cannabis).
18. *Capsicum minimum* ... ... (Capsicum).
19. *Carum copticum* ... ... (Ajowan).
20. *Carum carui* ... ... (Caraway).
21. *Cassia fistula* ... ... (Cassia pods).
22. *Cassia angustifolia* and *C. acutifolia* ... (Senna).
23. **Chenopodium ambrosoides var. anthelminticum.* ... (Chenopodium).
24. *Cinchona succirubra* and other varieties ... ... (Cinchona bark).
25. *Cinnamomum camphora* ... (Camphor).
26. *Cinnamomum zeylanicum* ... (Cinnamon).
27. *Citrus aurantium* ... ... (Bitter orange peel).
28. *Citrullus colocynthis* ... ... (Colocynth).
29. *Colchicum autumnale* and *luteum* ... (Colchicum).
30. *Convolvulus scammonia* ... ... (Scammony root).
31. *Coriandrum sativum* ... ... (Coriander).
32. *Croton tiglium* ... ... (Croton).
33. *Cucurbita maxima* and *C. pepo* ... (Cucurbita seminæ).
34. *Datura fastuosa* var. *alba* ... (Datura).
    ,, *metel*
35. *Digitalis purpurea* ... ... (Digitalis).
36. *Dorema ammoniacum* and other species ... ... (Ammoniacum).
37. *Elettaria cardamomum* ... ... (Cardamom).
38. *Eugenia caryophyllata* ... ... (Caryophyllum).
39. **Ephedra vulgaris* and allied species (Ephedra).
40. *Erythroxylon coca* ... ... (Coca leaves from which the B. P. drug, cocaine is derived).
41. *Eucalyptus globulus* ... ... (Eucalyptus).
42. *Euonymus atropurpureus* ... (Euonymus bark).
    Indian substitute. *E. tingens.*

*Not included in the B. P.

43. *Ferula fœtida* ... ... (Asafœtida).
Indian Substitute. *F. narthex*
44. *Fœniculum vulgare* ... ... (Fennel).
45. *Gaultheria procumbens* ... ... (Gaultheria).
46. *Gentiana lutea* ... ... (Gentian).
Indian substitute. *Gentiana kurroo.*
47. *Glycyrrhiza glabra* ... ... (Liquorice).
48. *Gossypium herbaceum* ... ... (Cotton root bark).
49. **Hemidesmus indica* ... ... (Sarsaparilla).
50. *Hyoscyamus niger* and *muticus* ... (Hyoscyamus).
51. *Ipomœa purga* and *Ipomœa orizabensis* ... ... (Turpeth).
52. *Jateorhiza calumba* ... ... (Calumba).
53. *Juniperus communis* and *J. macropoda* (Juniper).
54. *Linum usitatissimum* ... ... (Linseed).
55. *Lobelia inflata* ... ... (Lobelia).
Indian Subs. Lobelia nicotianifolia.
56. *Mentha arvensis* and *piperita* ... (Menthol).
57. †*Mylabris chicorii* ... ... (Cantharidis).
58. *Myristica fragrans* ... ... (Myristica, nutmeg).
59. *Papaver somniferum* ... ... (Opium).
60. *Peucedanum graveolens* .. ... (Anethi fructus or dill fruit)
61. *Picræna excelsa* ... ... (Quassia).
62. *Picrorhiza kurrooa* ... ... (Picrorhiza).
63. *Pimpinella anisum* ... ... (Anisi fruit).
64. *Pinus longifolia* ... ... (Turpentine).
65. *Piper cubeba* ... ... (Cubebs).
66. *Plantago ovata* ... .. (Ispaghula).
67. *Podophyllum emodi* ... ... (Podophyllum).
68. *Polygala senega* ... ... (Senega).
Indian Subs. *Polygala chinensis, P. crotalarioides.*
69. *Psychotria ipecacuanha* ... ... (Ipecacuanha).
70. *Ricinus communis* ... ... (Castor seeds).
71. *Rheum emodi* ... ... (Rhubarb).
72. *Rosa damascena* ... ... (Rose).
73. *Santalum album* ... ... (Sandal wood).
74. *Strophanthus* ... ... (Strophanthus).
75. *Strychnos nux vomica* ... ... (Nux vomica).
76. *Styrax benzoin* ... ... (Benzoinum).
77. *Swertia chirata* ... ... (Chiretta).
78 *Tamarindus indica* ... ... (Tamarind).

*Included in B. P. 1898.
†A product of animal origin.

79. *Taraktogenos kurzii* and *Hydnocarpus wightiana* ... .. (Chaulmoogra).
80. *Taraxacum officinale* .. ... (Taraxacum officinale).
81. *Terminalia chebula* ... ... (Myrobalans).
82. *Thymus vulgaris* ... ... (Thymol).
83. *Uncaria gambier* ... ... (Catechu).
84. *Urginea indica* ... ... (Urginea).
85. *Valeriana wallichii* and *V. officinale* (Valerian).
86. *Viburnum prunifolium* and *V. fœtidum* ... ... (Viburnum).
87. *Zingiber officinale* ... ... (Zingiber).

We will now study the most important of these drugs in some detail.

ACONITUM (N.O. Ranunculaceæ)

VERN.—Sans.—*Visha ;* Hind.—*Bachnag ;* Beng.—*Bisha ;* Bomb.—*Bachnab ;* Tam.—*Vashanavi.*

Aconite belongs to a genus of herbs belonging to the Natural Order *Ranunculaceæ* and the tribe *Helleboreæ.* The word 'aconiton', the classical Greek name, is derived most probably from 'Akwan' a dart, from its having been used to poison darts. The root, powdered and formed into a sticky paste with water, was smeared over the arrow heads.

Aconite is one of the oldest remedies used both by the Hindu and Mohammedan physicians in India and is one of the commonest drugs sold by druggists. The so-called 'ferox' variety is still largely used as an external application. The root is formed into a paste (*lep*) and is spread upon the skin as a remedy for neuralgia and other painful affections. Internally it is used in treatment of fever and rheumatism, usually in combination with other drugs ; it is also used as a remedy for cough, for asthma and for snake-bite. The Hindu physicians use some varieties as cardiac stimulants after prolonged boiling in cow's urine. By this process the active alkaloids are said to lose their depressant action on the heart and become stimulants instead.

The earliest reference to aconite in the Hindu medicine is about *A. heterophyllum* (Ativisha) which is mentioned in works

on materia medica by such authors as Chakradatta (1050 A.D.) and Saranghadhara (1363 A.D.). These writers recommended the use of the drug as a remedy in fevers, diarrhœa, dyspepsia and cough, and also as an aphrodisiac. The references to its use in Arabic and Persian works are short and probably originate from these Hindu works.

Another variety referred to, *A palmatum* (*Bikhma*), is intensely bitter like quinine, and in combination with pepper was used internally as a remedy for pains in the bowels, diarrhœa and vomiting, and as an anthelmintic against intestinal worms ; externally it was used as an application for rheumatism.

A number of laborious investigations—botanical, chemical and physiological—have been made on the subject of Indian and European varieties of aconite. The researches of Alder Wright, Cash, Dunstan and Stapf have exhaustively dealt with it. Different workers have adopted different methods of classification according to the plants being poisonous or non-poisonous, annual, biennial, perennial, or according to the structure of their root sections, etc. It, therefore, comes about that many new names have been substituted for the older ones and this has led to a good deal of confusion. When a pharmacist in India has to select a sample for his use, he has to go through the whole literature on the subject, most of which is out of print, in order to identify his sample and get information about it. It should also be remembered that the alkaloids of aconites readily undergo changes in their chemical composition under different conditions of age, temperature, moisture, storage, etc., so much so that sometimes older samples have been found to be seriously deficient in their active principles. One cannot, therefore, rely on roots of questionable age.

Up to the present time the Indian aconites have been used in this country in preparations used for external application only. It seems strange that they are not used for preparing tinctures, etc., because their alkaloidal content is high and they are very active. From the pharmacological and economic points of view, these are the properties for which they ought to be preferred. The reason undoubtedly is that they have not been properly standardised. If this is done and their therapeutic value is established, there is no reason why they should not be used in medicine on a larger scale than heretofore. The author and his co-workers have carefully studied the different varieties of aconite growing in India and have cleared up the confusion

existing regarding their activity. In order to understand thoroughly the present position regarding the aconites of the Indian market, it will be necessary to go into the classifications that have been adopted for it from time to time.

Indian Aconites of Commerce According to Old Classification

Altogether there are said to be about 180 species growing in the northern temperate zone, but over 50 European varieties and 24 Indian species have been admitted and a number of these have been shown to contain active alkaloids. The members of the genus that grow in India are exclusively confined to alpine and subalpine regions of the Himalayas from Nepal to Kashmir. According to Watt, six species of aconite, recognised by the botanists, grow in India, with two or three varieties under two of these species.

1. *A. heterophyllum.*—VERN. Sans.—*Ativisha;* Hind.—*Atis;* Beng. —*Ataicha;* Tam.—*Ati-vadayam* and Pers.—*Vajjeturki.* It is well known to the hill people as being quite inert and it is eaten by them as a vegetable. It grows in the Himalayas at an altitude of 6,000 to 15,000 feet above the sea level. The root is commonly employed in indigenous medicine as a mild and bitter tonic and is sold in the bazars under the name of 'Atis' or 'Atees.'

2. *A. napellus.* VERN. Sans.—*Visha;* Hind.—*Mithazahar;* Beng.—*Katbish.* Several varieties grow abundantly in the temperate alpine Himalayas at an altitude of 10,000 to 15,000 feet above the sea level. Four varieties, *napellus* proper, *A. rigidum, A. multifidum* and *A. rotundifolium* are commonly known. Some of these varieties are poisonous and others are non-poisonous. It may be mentioned here that all *A. napellus* sold in the Indian bazars is not the produce of India. Quantities of imported European root also find their way into commerce.

3. *A. ferox.* VERN. Sans.—*Visha;* Hind.—*Bish;* Beng.—*Katbish;* Tam.—*Vashanavi;* Guz.—*Vachnag;* Pers.—*Bishnag;* *Arab.*—*Bish.* Most of the drug used in this country is said to be derived from *A. ferox,* but no exact information is available on this point. This variety was popularly believed to grow abundantly in India, mainly confined to the eastern temperate sub-alpine regions of the Himalayas eastward of Kumaon at an altitude of 10,000 to 14,000 feet above the sea level. It was differentiated from *A. napellus* by its leaves being less divided, its flower racemes being denser and there being a shorter beak to the helmet. *A. ferox* was considered to be undoubtedly poisonous. It was commonly known as the 'Indian aconite', as most of the

root sold in the Indian bazars was believed to be derived from this variety, though undoubtedly it was adulterated with roots from other varieties.

4. The white spongy root which is exported from Northern India is known as 'Lahore Bachnab' or 'Mitha-zahr'. This root is devoid of the peculiar smell of the *A. ferox* root and is probably derived from *A. lycoctonum* which grows abundantly from Kumaon to Kashmir (Western Himalayas) at an altitude of 7,000 to 10,000 feet above the sea level.

5. *A. luridum* is found largely in Sikkim. It finds its way into the market and is sold mixed with other varieties.

6. *A. palmatum* grows in the eastern temperate Himalayas from Garhwal to Manipur, but this species also is not poisonous and is not sold except as an adulterant to active varieties.

In European commerce, all the Indian forms of aconite were classed as forms of *A. ferox*, but it should be remembered that true *A. ferox* is not the most plentiful of the aconite roots in this country and certainly not the most accessible. It thus comes about that the so-called Aconite ferox sold by the druggists is an indiscriminate mixture of the roots of *A. ferox*, *A. lycoctonum*, *A. napellus* and *A. palmatum*, the latter predominating. That this state of affairs has been going on for many years is evident from the remarks made by Dr. E. R. Squill in the Year-Book of Pharmacy, 1873. He said that although only a few drugs are apparently more cheaply and easily obtained than aconite root, yet perhaps in no other is there so great an amount of uncertainty, many parcels having been found to be comparatively worthless from a medical point of view. Things have, however, improved since then and most of the important active varieties are available in the market, though not without difficulty on account of the tendency to adulteration with cheaper and inactive varieties.

Indian Aconites of Commerce According to New Classification

Names of Type	Species and Varieties Included in Type
Napellus ...	... *A. napellus*, *A. ferox* var. *laciniatum* and *A. ferox* var. *spicatum*.
Atrox ...	... *A ferox* var. *atrox*, *A. ferox*, var. *polyschiza*.
Anthora ...	... *A. heterophyllum* and *A. papcratum*.

Later, Stapf (1905) divided the Indian aconites into three types according to their being annual, perennial and biennial :—

(1) Gymnaconitum type (annual duration) *A. gymnandrum.*

(2) Lycoctonum type (perennial) *A. læve, A. luridum, A. moschatum.*

(3) Napellus type (biennial and normally paired).

He also classified them according to their root structures as follows, and this is the classification which is now accepted by botanists.

Napellus Type	Anthora Type	Deinorrhizum Type
A. soongaricum.	*A. rotundifolium.*	*A. deinorrhizum.*
A. chasmanthum.	*A. heterophyllum.*	*A. balfourii.*
A. violaceum.	*A. naviculare.*	
A. falconeri.	*A. palmatum.*	
A. spicatum.	*A. hookeri.*	
A. laciniatum.		
A. ferox.		
A. heterophylloides.		
A. leucanthum.		
A. dissectum.		
A. jaduar.		

In the light of this new classification, the position of common commercial aconites of India is as follows :—

A. heterophyllum belongs to the Anthora type of Stapf. The non-crystalline alkaloid *atisine* is non-toxic and is employed medicinally in this country as an antiperiodic, aphrodisiac and tonic.

True *Aconitum napellus* is the European variety which is imported and sold in this country. Its active principle is the alkaloid *aconitine.*

Aconitum napellus (*Mohri*) is the *A. chasmanthum,* Stapf, which grows abundantly in India. It was formerly considered to be indentical with *A. napellus* of European species to which it is closely allied. The alkaloid obtained from this species is named *indaconitine ;* it melts with decomposition at 202—203°C., closely resembles aconitine in its physiological action, but differs only in degree.

The so-called *A. ferox* of Indian commerce has been shown to be a mixture of four species according to Stapf's

classification. They are *A. deinorrhizum*, *A. balfourii* of the *deinorrhizum* type, the former growing in Bashahr and the latter in Garhwal, Kumaon and Nepal; both contain the crystalline *pseudo-aconitine*, and *A. spicatum* and *A. laciniatum* of the Napellus type of Stapf growing in Sikkim and Bhutan, contain the non-crystalline *bikhaconitine*. Some of the specimens obtained consisted only of the two former varieties. The physiological action of both these alkaloids closely resembles that of aconitine. *A. ferox* proper of Stapf is a rare, poisonous species which has only been found once by Wallich in Northern Central Nepal. We are informed by the Conservator of Forests, Kashmir State, that true *A. ferox* has been found also in some parts of the Northern Himalayas.

A. lycoctonum according to Stapf is of a perennial type and three species are included under it—*A. læve*, *A. luridum* and *A. moschatum*. These are non-toxic and the species we examined had very slight traces of the alkaloid *lycaconitine*. We could not isolate sufficient quantity of the alkaloid to investigate its physiological action fully, but it is absolutely non-poisonous. It is said to contain an alkaloid called *palmatisin* which is physiologically inactive. We were unable to isolate any alkaloid from the samples we analysed.

Standardisation of Indian Aconites of Commerce:—*Chemical assay.*—Formerly aconite was standardised by the chemical method as laid down in United States Pharmacopœia VIII. In U.S.P. IX Revision, the official assay process is also a chemical one with an alternative biological assay method, but the chemical method was accepted as the standard and was generally used. Later it was shown by various workers that considerable variations and inconsistency in the potency of aconite preparations existed, when assayed by chemical and biological methods. This is due to the fact that, though the various alkaloids present in the root behave similarly to solvents and precipitants, their pharmacological action and toxicity vary considerably. Chemical methods only indicate the total alkaloids, whether active or inactive, whilst aconitine and the allied alkaloids such as indaconitine and pseudaconitine are the ones that are responsible for the physiological activity of the drug.

For this reason several biological methods of assay were developed.

Table A shows the total ether-soluble alkaloid contents of the common Indian varieties of aconite roots sold in the bazars. The so-called *Aconite ferox* which has been shown to be a mixture of *A. deinorrhizum* and *A. balfourii* (Stapf) contains 0.86 per cent. of the total alkaloids. Of the two samples of *A. napellus* (*A. chasmanthum*, Stapf) obtained from two different parts of India, No. 1 contained 4.28 per cent. and No. 2 contained 4.50 per cent. of the total alkaloids respectively. In the European variety of *A. napellus* the total alkaloid content is 0.4 to 0.5 per cent. so that the alkaloidal content in the so-called ferox variety is nearly double and in chasmanthum variety nearly ten times more. The other varieties in the market are *A. heterophyllum* and *A. lycoctonum*; they contain small quantities of alkaloids which are physiologically not very active.

TABLE A

Chemical Assay of Aconites on the Indian Market

Name according to old classification	Name according to the classification of Stapf	Name of the alkaloids isolated	Percentage of total ether soluble alkaloids	Melting point of alkaloids	Crystalline or non-crystalline	Remarks
Aconitum napellus (Mohri). Specimen 1.	*A. chasmanthum* allied to European *A. napellus*.	Indaconitine.	4.50	202-203°	Crystalline.	Closely resemble aconitine.
Aconitum napellus Specimen 2.	...	...	4.28	...	Do.	..
Aconitum ferox.	This specimen was a mixture of *A. deinorrhizum* & *A. balfourii.*	Pseudaconitine.	0.86	211-212°	Do.	Physiological action resembles aconitine but is more powerful.
Aconitum heterophyllum.	Belongs to Anthora type of Stapf.	Atisine	0.38	85°	Non-crystalline.	...
A. lycoctonum.	Belongs to perennial type of Stapf and include *A. luridum.*	Lycaconitine (only a minute trace of the alkaloid was obtained).	..	...	...	..

Biological Assay:—Aconites are better assayed, not by chemical methods but by biological methods. The 'guinea-pig' method of estimation of the alkaloids consists in finding out the minimum lethal dose of a given specimen to these animals according to their body weight, and comparing it with the quantity of pure crystallised aconitine required for the same purpose as a standard. This method gives a fairly accurate idea of the active principles present in a given specimen. We employed this method for assay of roots of different Indian varieties. It was found that the alkaloids of the so-called Ferox variety were about 1.5 times stronger and that of the Indian napellus variety 0.7 times weaker than the aconite of European variety. But the alkaloidal content of the ferox variety is double and Indian napellus (*A. chasmanthum*) 10 times more than that of the European napellus variety.

To briefly summarise the present position of Indian aconites:

(1) The common poisonous varieties of aconites on the Indian market are:—

(*a*) The so-called Ferox variety known as the 'Indian Aconite.' This has been shown to be a mixture of *A. deinorrhizum* and *A. balfourii* of Deinorrhizum type of Stapf. Two other varieties are often found mixed in it, *i.e.*, *A. spicatum* and *A. laciniatum* belonging to the Napellus type of Stapf.

(*b*) The Indian Napellus variety is now known as *A. chasmanthum*, Stapf. The other varieties sold are *A. heterophyllum* and *A. lycoctonum* which are entirely non-poisonous.

(2) Chemical assay of these varieties shows that the alkaloid content of the so-called Ferox form (*A. deinorrhizum* and *A. balfourii* combined) is double that of the European variety of *A. napellus* official in the Pharmacopœia, and that of the Indian Napellus variety (*A. chasmanthum*) is ten times as much.

(3) Biological assay of these roots shows that the ether soluble alkaloid (pseudaconitine) of the so-called Ferox form is 1.5 times stronger than aconitine obtained from the European variety of *A. napellus* and the alkaloids obtained from the Indian variety of napellus (*A. chasmanthum*) are 0.7 times weaker.

From a comparison of the chemical and biological assays of the different species of aconite that were examined, it can be concluded that both Indian varieties, *i.e.*, *Aconite napellus* and the so-called *Aconite 'ferox,'* can be used for the purpose for which aconite roots of the British Pharmacopœia are used. The other varieties sold in the market have quite different physiological properties and cannot be used. For practical purposes it would appear preferable to bring into use the aconites sold under the name of ferox, (the commonest in the market) for the following reasons:—(1) They are very common in the bazars and available in large quantities under the name of *bachnab, bachnag, mithabish, mitazahar, singyabish* and *dagra.* (2) They can be easily distinguished and their adulteration with any other variety can be easily detected, which is not the case with the napellus variety. (3) They are very easily identifiable both by their botanical and chemical characteristics. The tubers are sometimes single or more generally 2—3 fasciculated, fusiform 2″—5″ long, ¾″—1″ in diameter (at the thickest portion), dark brown or nearly black externally. (4) The outer cuticle is thick and prevents to some extent the access of moisture. They do not deteriorate rapidly, and have a fairly constant composition owing probably to their being of a uniform variety. (5) The alkaloid can be very easily crystallised, about 80 per cent. being crystallisable, so much so that from an assay sample of about 10 grams of the root pure crystals are obtainable for identification.

References :—

(1) Allen, 1929, *Commercial Organic Analysis*, Vol. VII ; (2) The Aconites of India (Stapf), 1905, *Ann. Roy. Botanical Gardens*, Vol. X, Part II, Calcutta; (3) Dunstan, 1897, *Agricultural Ledger*, No. 19, p. 373; (4) Chopra and others, 1928, *Ind. Jour. Med. Res.*, Vol. XV, April; (5) Chopra and others, 1929, *Ind. Jour. Med. Res.*, Vol. XVI Jan.; (6) Henry, T. A. and Sharp, T. M., 1928, *J. C. S. Trans.*, p. 1105; (7) Sharp, T. M., 1928, *J. C. S. Trans.*, p. 3094.

ALOE VERA, ALOE INDICA (N.O. Liliaceæ)

VERN.—Sans.—*Ghrita kumári* ; Hind.—*Kumári* ; Beng.—*Ghrita kumari* ; *Musabbar* ; Tam.—*Kumari.*

The uses of aloes, the common 'musabbar', for external application on inflamed painful parts of the body and for causing purgation are too well-known in India to need any special comment. Its application in medicine dates back to the 4th century B.C. It is the product mostly of *Aloe chinensis* and *Aloe perryi,* plants indigenous to East and South Africa, which have been introduced into the West Indies and other tropical countries. The plants have large fleshy leaves from which a thick juice flows when they are detached by means of transverse cuts. The juice is allowed to drain into suitable vessels and then concentrated by evaporation, sometimes spontaneously but more frequently by boiling. The juice is colourless to start with but darkens, due to evaporation and boiling, and hence the commercial drug is met with in dark hard masses. Most of the aloes, if not all, met with in commerce is imported into India. Several varieties of the plant, however, are common on the sea coast of Bombay and Gujerat of which *Aloe vera* var. *officinalis*, also known as *A. indica,* only appears to be truly indigenous to India. It is a coarse-looking plant with big leaves, found in Mysore and certain parts of the Madras Presidency. It has been identified as the ancient 'ghrita kumári' of the Vedas. *Aloe abyssinica* is grown in Jaferabad in Kathiawar and *Aloe vera* or *Aloe barbados* have become completely naturalised in India especially in the hot dry valleys of the north-western Himalayas and throughout the central tableland extending as far as Cape Comorin. Although the drug yielded by the Indian plant seems to be in no way inferior, *A. socotrina* is most highly esteemed, figures most in the trade returns, and is imported into Bombay *via* Zanzibar and direct from the Red Sea ports. It is usually sent from these parts packed in skins, the packages varying much in size and shape. In Bombay, the skins are opened and aloes repacked uniformly in boxes for export to Europe. The re-export forms only a small part of what is imported, and the major part is meant

for consumption in India. A glance at the sea-borne trade statistics of British India shows that nearly Rs. 37,000 worth of aloes on an average is imported into India. Although aloes does not grow largely in a state of nature, the cultivation of the plant is easy and as it flourishes in the driest and poorest of soils, is could be easily produced.

References :—

(1) Humphreys, 1912. *Drugs in Commerce.*

ARCHIS HYPOGÆA (N.O. Leguminosæ)

Ground Nut ; Pea Nut ; Monkey Nut.

VERN.—Sans.—*Buchanaka* ; Hind.—*Mungphali* ; *Beng.*—*Chine-badam* ; Bomb.—*Bhui-chane* ; Tam.—*Vérk-kadalai*, Tel.—*Verushanaga-káya*.

The plant *Arachis hypogæa* is largely grown in South America, East Indies, China, Japan, the French West African Colonies (Congo) and Senegal. In India, Arachis is one of the most important of the cultivated plants, being grown throughout the country but chiefly in South India and Bombay. It is also available in certain parts of Bengal and Upper India. The seeds of this plant, besides being extensively employed as a food-stuff, afford on expression 40 to 50 per cent. of a clear straw coloured, non-drying oil with a faint odour and a very mild agreeable taste. It closely resembles olive oil both as regards taste and other physical and chemical properties. A comparison of the constants of the two oils will reveal this similarity in a striking manner:—

	Ground-nut Oil	Olive Oil
Sp. gr. at 15°C ...	0.9165 to 0.9175	0.916 to 0.918
Solidifying point ...	0 to 2°C	3 to 4°C
Refractive index at 15°C ...	1.4731	1.4698 to 1.4703
Saponification value ...	185.6 to 196	185 to 196
Iodine value ...	83.3 to 105	79 to 88 usually

Arachis oil contains oleic, hypogæic, palmitic and arachic acids and it is greatly esteemed for domestic purposes as it does not become so rancid as other oils. The oil is also regarded in India as an aperient and emollient.

Olive oil is largely employed in medicine, both externally and internally. It is a basis for liniments and ointments. It is also a nutrient and a food and can be given in wasting diseases. Arachis oil satisfies almost all the properties possessed by olive oil so that it can be used as a substitute for it, particularly in India, where arachis oil is available in large quantities at a very cheap price in contradistinction to olive oil which is very expensive. The substitution of arachis oil for olive oil is actually carried on in commerce to a very large extent. Most of the specimens of 'pure lucca olive oil' from France and Italy are not true 'olive oils' but 'arachis oil' purified and passed on as 'olive oil.' This arachis oil is derived from the groundnuts exported to the continent from the Madras ports.

References :—

(1) Lewkowitsch, 1922, *Analysis of Oils and Fats.*; (2) Louis, E. Andés, 1917, *Vegetable Oils and Fats.*

ARTEMISIA MARITIMA (N.O. Compositæ)

Wormseed ; Santonica.

VERN.—Hind.—*Kirmálá ;* Bomb.—*Kiramaniowa ;* Pers.—*Shih, Sariqun ;* Arab.—*Afsantin-el-bahr.*

The plant artemisia is a very ancient remedy and was extensively used by the Greeks and Romans to expel intestinal worms and as a stomachic. The old Arabian and Persian physicians used it for the same purpose and it was probably introduced into India by them, as no mention of this drug can be found in the old Ayurvedic writings. The flowering tops have been and are to this day largely used in the Tibbi (Mohammedan medicine) in India as an anthelmintic. Usually they are powdered and are given in 2 to 4 drachm doses.

The drug is also used as a remedy for dropsy. A decoction made from the plant, which would consist mainly of the essential oil, is used as a cardiac and respiratory stimulant. *Artemisia maritima*, Linn. (*A. brevifolia*, Wall) grows abundantly in the high altitudes of the Himalayas from Kumaon to Kashmir at a height of 4,000 to 12,000 feet. It is said to grow more abundantly and uniformly in Beluchistan, Chitral and Afghanistan than in the Himalayas. It grows in such abundance in the last-named country that it is used as a packing material for fruit which is imported from Kandahar. In spite of this abundant supply, santonin was not manufactured in India either for internal consumption or export till very recently.

Before the War, practically all the santonin on the Indian market was of Russian origin and was imported from Europe. It was obtained from *Artemisia cina*, Berg, but there are many allied species, such as *A. maritima*, var. *Stechmanniana* Besser (*A. lercheana*, Karel and Kiril), *A. pauciflora*, Stechm, etc., which are indigenous to the vast uncultivated plains of the Kirghiz in Turkestan. A number of species of artemisia are also widely distributed over different parts of Europe, Asia and America. Formerly large quantities of the strongly-aromatic flower heads were collected and sent to the European markets, especially to Moscow and Petrograd: some also found their way to India *via* Afghanistan and Persia. Factories were later established in some of the large towns in Turkestan where santonin is extracted, and mainly the purified product is now exported. Some years ago there was a great scarcity of santonin, owing to the wasteful and destructive methods of collection, and to the political and economic upheaval in Russia. Efforts were, therefore, made to find other sources of the drug with a view to increasing its output. The plant, however, is found only in a restricted area in Russian Turkestan and attempts at the extension of cultivation have hitherto failed. Extensive investigations have also been carried out from time to time on other plants of the same genus, as additional or alternative sources of santonin. In Holland, Van Laren has successfully cultivated *A. cina*, which has yielded as much as

1.3 per cent. of santonin. Some of the American species of artemisia growing in Mexico and the neighbouring states have also yielded santonin. *Artemisia gallica* grown in France was found by Heckel and Schlagdenhauffen to contain santonin, although the percentage was not stated by them. An examination by Maplethorpe in 1924 of *Artemisia gallica* and *A. maritima* found in the south of England led to the conclusion that the English variety of these plants contained very little or practically no santonin. Despite the large amount of work done on various species of artemesia, it has not yet been possible to find a variety which contains a workable percentage of santonin and which can stand comparison with the Russian variety.

Indian Species of Artemisia:—Many species of artemisia grow in the Himalayas but *Artemisia brevifolia*, Wall, which contains santonin grows fairly abundantly in certain parts of Kashmir (Gurez, Telel, Astore, Baltistan, etc.). Gurez, which is near the main valley of Kashmir, and therefore accessible from the point of view of transport, can yield about 150 tons of the dry material annually and this yield can be considerably increased. Large quantities can also be gathered from the neighbourhood of Astor but transport is more difficult. A factory for the manufacture of santonin in Kashmir has been under consideration for some time, and although a certain amount of santonin has been produced, it has not been done on a commercial scale. The reason probably is that the price of artemisia charged by the authorities is very high. Unless this is reduced there is no likelihood of this industry making any headway.

Within recent years (1926-27), a new source of santonin has been discovered in India. In the Kurram valley in the North Western Frontier Province, at a height of 4,000 to 5,000 feet above the sea level, artemisia has been found growing in abundance. The area, under artemisia first discovered was estimated by the Botanical Survey Department to be roughly 200 acres of fairly thick crop, but there are many similar areas in the adjacent hills and there is a larger tract of more than 2,000 acres, with a crop of varying density scattered over it. Several closely related species of artemisia have been collected

from this locality. *Artemisia maritima* is found in most parts of this valley and is known by the name 'Spirah tarkhah' and this is the variety which bears santonin. The other species such as *A. salsoloides, A. absinthium, A. campestris* and *A. vulgaris,* which were collected showed no santonin whatsoever. The discovery of this new source of santonin in India is of far-reaching importance to the drug world. The estimated yield of saleable product that could be obtained from the locality is indeed very satisfactory. About 1,700 lbs. of green leaves and stalks can be obtained from one acre, and after drying and removing the stalks about 425 lbs. per acre of saleable product could be easily collected. This is the minimum estimate, and if properly protected by closing certain areas to grazing, the area would in a year of normal rainfall yield about 6,000 lbs. of green crop giving 1,500 lbs. of saleable product per acre. According to this computation, from 200 acres of thick crop it will be possible to get a hundred tons of good leaf and if the other available and adjacent areas are worked up, there is no doubt that a constant supply of 100 to 200 tons could be maintained for years, specially because the crop could be cut twice a season both in June and September. This will place India in a very promising position as regards her santonin requirements. Preliminary analyses carried out on the Kurram valley artemisia showed a poor santonin content, almost half the quantity found in artemisia growing in Kashmir. The commercial exploitation of this source may, therefore, appear to be a risky venture, but the proximity of these areas to the railway and the consequent saving in transit charges are important factors. Further work is in progress with regard to future possibilities there in connection with this drug. Besides the artemisia already growing wild, a very large area of waste land is capable of cultivation, and it would only be necessary to protect and give it an occasional watering to produce a good crop. If these operations are successful, it is to be expected that India would not only be completely self-supporting as regards her santonin requirement, but would be able to export a large amount.

Santonin Content of Indian Artemisia

The active principles of *A. maritima* consist of :—

(1) a volatile oil which has an odour resembling cajuput oil and camphor,

(2) santonin and an allied body artemisin.

The amount of santonin extracted from the Russian artemisia usually is 1.2 to 1.4 per cent., but may be as high as 2.3 to 3.6 per cent. It appears from several analyses made by Dr. Greenish, Dr. Simonsen and the chemists of the Imperial Forest Research Institute, that as much as 1.95 per cent. of santonin may be obtained from flower buds and leaves. Later estimations, however, have proved that the yield from the Kashmir artemisia is lower still and seldom goes beyond 0.5 per cent. This is partly due to the fact that the santonin content of *A. maritima* from these regions is naturally somewhat low, and unless it is collected at the proper time, the yield is still further reduced. It has been shown that the plants collected in June from Kashmir (Gurez) have no santonin at all; those collected in July and August showed from 0.1 per cent. to 0.9 per cent., the latter being the maximum yield. In the first half of September, the santonin content again falls to 0.1 per cent. and after that, it is entirely absent, or only traces are present.

The method of extraction of santonin followed by the chemists in India is said to be responsible to a certain extent for the low yield. In the factories of Russia, santonin is extracted by a new and improved method said to be devised by Dr. Ferdinand Krauss of Braunschweig. This method allows nearly 98 per cent. of the santonin content to be extracted from the flower buds of the plants, whereas in India, only 70 per cent. to 80 per cent. of the santonin is made available. If the former method is used, the yield could be increased by cutting down the waste which is at present sustained in the process of extraction.

The method of collection of the plant has also been defective. In old days, the whole plant was cut off from the root and the flowering tops, the leaves and the stalks were all mixed together. As the woody stalks contain little or no santonin, this process further helped to reduce the percentage. The method now employed is to strip off the leaves and flower-buds directly from the plant by hand and then dry them in the sun. This method is less wasteful, as the plants from which the leaves and flower-buds are stripped off, do very well. Not only is their future growth and development not hindered, but they bear fresh leaves. The cutting off of the whole plant is not only harmful from point of view of future growth, but is also expensive both for labour and transport.

A comparative examination of the physical and chemical properties of the Indian santonin shows that it practically comes up to the

Russian santonin. A perusal of the following table will make this point clear :—

Imported Russian Santonin (Standard)	Indian Santonin (Smith Stanistreet brand)
1. Very sparingly soluble in cold water. Soluble in 40 parts of cold rectified spirit, in 3 parts at the boiling point and in 4 parts of chloroform ...	Same as the standard.
2. Crystallises in flattened columns, in feathery radiating groups or in flaky plates. Odourless, tasteless at first but afterwards develops a bitter taste. The cold alcoholic solution has an extremely bitter taste	Do.
3. When heated becomes reddish brown, evolves white fumes and on cooling sets to a clear brown vitreous mass, which is reddened on treatment with a little dry alkali or slaked lime	Do.
4. On exposure to light, especially to direct sunlight, santonin acquires a yellow colour. The hot alcoholic solution of this altered substance is yellow, but deposits crystals of colourless santonin on cooling ...	Do.
5. Laevo-rotatory in chloroform − 171.4°	Laevo-rotatory in chloroform − 161.2°
6. Specific gravity 1.1866	Same as the standard.
7. Melts at 171° to 172°C	Softens at 169°C and melts completely at 171°C.
8. Leaves no appreciable ash ...	No appreciable ash.

The slight differences noticed are probably due to traces of impurities. The pharmacological action and toxicity of the Indian variety also correspond to those of the variety imported from Europe. A series of cats, whose stools were previously examined and found to contain ova of belascaris and hookworm, were given the drug in doses ranging from 45 to 80 mgm. The belascaris were expelled and the ova disappeared from the stools. No toxic symptoms were produced in these animals.

The therapeutic efficacy of the drug was tested by clinical trials in a large number of cases in the Carmichael Hospital for Tropical Diseases and in the Alipore Central Jail. Indian santonin was given combined with calomel and sodium bicarbonate. The stools were carefully washed for 48 to 72 hours after administration of the drug and examined for the presence of the parasites. Ten days later the stools were re-examined by the Kofoid and Barber technique for the presence of ova. The results with Indian santonin compared favourably with those ordinarily obtained with European santonin. It was found to be more effective on ascaris than chenopodium.

Recent studies by Dr. Maplestone have shown that a combination of santonin and chenopodium is very much more effective in the treatment of ascaris than either of these drugs alone.

Economic Possibilities:—Santonin is one of the most expensive drugs in the Pharmacopœia, its current price being Rs. 400/- per pound. During the War and for some time after, it was selling at Rs. 700/- per pound, a single dose of 3 grains costing nearly a rupee. For mass treatment in a poor country like India, it is essential that some source shall be found from which santonin can be obtained at a cheap price. From the information available now, it appears probable that India could produce at a reasonable price, much larger quantities of this drug than she requires herself.

The incidence of ascaris and oxyuris infections amongst the population of this country is very heavy indeed. This will be seen from an estimate by the Helminthological Department of the Calcutta School of Tropical Medicine and Hygiene. Over 65 per cent. of the population seems to be affected in Burma, Assam, Orissa and parts of Madras, where the rainfall is heavy and the surface water abundant during the monsoon season. In Bengal and parts of Bombay the incidence is from 35 to 50 per cent. and in the United Provinces, it varies from 15 to 25 per cent. In the drier parts of India like the Punjab and Rajputana, though the incidence is less than in the parts mentioned above, it is in no way insignificant. The huge demand for santonin can, therefore, be easily appreciated.

Under the circumstances, the development of the santonin industry will be beneficial to all concerned.

References :—

(1) Chopra & Chandler, 1924. *Ind. Med. Gaz.*, Vol. LIX, Nov. (2) Chopra & Ghosh, 1926. *Ind. Jour. Med. Res.*, Vol. XIII, Jan. (3) Allen, 1928. *Commercial Organic Analysis.*, Vol. VI. (4) Maplestone, P. A. & Mukerjee, A. K., 1931. *Ind. Med. Gaz.*, LXVI, Nov. (5) Chopra, R. N. & Mukerjee, B., 1931. *Ind. Med. Gaz.*, LXVI, Nov.

ATROPA BELLADONNA (N.O. Solanaceæ)

Deadly Nightshade

VERN.—Hind.—*Sag-angur* or *Angur-shefa* ; Beng.—*Yebruj.*

Belladonna and its alkaloid atropine are largely used in the Western medicine as a sedative, antispasmodic and mydriatic in diseases of the eye. It is a valuable antidote in poisoning by opium, muscarine, etc. Belladonna is a tall, straight plant, sometimes attaining a height of 7 feet, but ordinarily 3 to 4 feet high. It grows in great abundance in the Himalayan ranges extending from Simla to Kashmir at an altitude of 6,000 to 12,000 feet above the sea level and is also found wild in Kunawar at an altitude of 8,500 feet. An unlimited supply of the root can be obtained from the northern Himalayas from localities not too far away from places with suitable transport facilities.

Although it is a powerful drug, its medicinal properties appear to have escaped the ancient physicians of India as it has not been mentioned in the Hindu materia medica. It is remarkable that, while absolutely worthless drugs were carefully collected and sent to the plains of India from the very localities in which belladonna is abundant, not a single leaf or root of Indian origin of this valuable drug could be purchased from the Indian drug shops in large centres some years ago. Its identity was so much eclipsed that no mention of this drug could be found in Dymock's Pharmacographia Indica or in Mohideen Sheriff's book both of which are known to be very exhaustive and reliable treatises on the Indian indigenous drugs. Apart from the natural sources of belladonna in the hilly regions of India,

considerable quantities of the roots could be grown in various suitable situations in India. The important factors in the cultivation of belladonna are regular drainage, a soil having porosity and containing sufficient mineral constituents, *e.g.*, potash, soda, lime, etc., a warm hilly situation with protection from sunlight by deciduous trees and sufficient room for the roots extending to a distance from the parent plants. These requirements are not difficult to attain and as not much manuring is required in belladonna plantations, a heavy item of expenditure on this score is dispensed with. There is every possibility that belladonna cultivation would succeed, in view of the fact that in India fungus disease of the belladonna roots, which has caused havoc in the plantations in some of the foreign countries, is not yet reported.

Medicinal preparations of belladonna and its alkaloid atropine are largely imported into India. It is interesting to note that most of the galenicals and the alkaloid are prepared from the belladonna roots and leaves exported from India. A perusal of the records shows that a considerable export trade in these raw materials has existed between India and Europe for a long time. During the War, this trade flourished extraordinarily and unprecedented values were realised by the growers, partly due to general scarcity of the article in the world market and partly to the reputation of the Indian root as possessing an alkaloidal content much higher than the European varieties. The Indian belladonna actually contains a higher proportion of alkaloids as will be seen from the analyses which were carried out. A number of specimens of the roots contained 0.81 per cent. of total alkaloids, as compared with 0.45 per cent. laid down in the British Pharmacopœia, and the leaves contained 0.50 per cent. as compared with 0.3 per cent. Of late years, the price of roots and leaves in foreign markets has gone down and the Indian export trade has received a set back. Like many other raw products of Indian origin, Indian belladonna is already looked down upon in foreign markets; for this the Indian dealer is not a little to blame. Adulteration has been practised to a great extent. Not only plants in all stages of growth have been collected, but a variety known as *lutescens*

with a low alkaloidal content has frequently been substituted. A large portion of the wild Indian belladonna exported to England of late years, consists of the *lutescens* variety. Further, in view of the fact that no cultivation on scientific lines exists anywhere in India, a steady supply and uniform quality of the drug cannot be ensured.

Though the export trade in belladonna has decreased considerably, a happy feature noticeable lately is that the manufacturing firms in Calcutta have now taken to the preparation of the galenicals from the Indian root for the use of the public. The alkaloid is not manufactured by any firm in India as yet, but there is no reason why this should not also be done in the near future.

References :—

(1) Chopra & Ghosh, 1926, *Ind. Jour. Med. Res.*, Vol. XIII, Jan.; (2) Dutt, 1928, *Commercial Drugs of India.*

CAMELLIA THEIFERA (N.O. Ternstrœmiaceæ)

The Tea plant

VERN.—Ind. and China.—*Cha, Chai*

COFFEA ARABICA (N.O. Rubiaceæ)

The Coffee plant

VERN.—Arab. and Ind. Bazars.—*Kahvah.*

Caffeine is one of the most important alkaloids used in medicine. Its properties, as a stimulant to the central nervous system and circulation, and as a diuretic, make it a very valuable therapeutic agent. Both the alkaloid and its salts, *e.g.*, caffeine citras, caffeine soda benzoas, etc., are largely employed in medicine.

Caffeine is the principal alkaloid occurring in tea and coffee plants and in similar stimulants such as Kola nut, Maté or Paraguay tea and Guarana paste. It is also contained in the leaves of the *Theobroma coca* but only in very small amounts. The various peoples of the world prefer different caffeine beverages, but coffee and tea alone are really competitors. There are constant national preferences with respect to them. The number of plants used as substitutes for genuine tea in different parts of the world is very large and nearly 200 are known. These plants, as a rule, do not contain caffeine; some of them contain

an essential oil but do not possess the properties of the purine compounds, caffeine, theobromine, etc.

It is well known that tea—both its name and the beverage itself—came originally from China. The habit of taking tea had existed there from very early times and it is probable that it was in use as a drink in the 5th century, if not earlier. It was also known in India (Assam) from very early times but the exact period when the use of tea started is not known with any degree of precision. At the beginning of the 9th century, it reached Japan, but it was not till the end of the 16th century that the rest of the world became acquainted with the properties of tea. It was introduced into England early in the 17th century but in the year after the Restoration it was still a curiosity. In the days of Queen Anne, tea began to be a frequent though still occasional indulgence of the fashionable society but as the centuries wore on, tea drinking spread rapidly and became no longer a curiosity or a fad but a regular habit and a part of people's dietary. In 1636, tea was drunk in Paris and shortly afterwards it found its way into the different countries of Europe. During recent years tea drinking has become universal all over the world. In India 50 years ago, very little tea was drunk and it was practically unknown in the plains of northern parts of India, especially in the rural areas and among the poor. Nowadays tea as a beverage is used even in the most out of the way places and even by the poorest. Consumption of tea has increased enormously in this country during the last 30 years.

Coffee (*Coffea arabica*) had been known for a long time to the Arabs or Persians and from them, it is believed, the habit of coffee drinking spread to Europe and other countries. The Kola nut (*Sterculia acuminata*) is used by the population of the vast territory of the Sudan (Central Africa) between the Atlantic Ocean and the source of the Nile. The Yerba Maté or Paraguay tea (*Ilex paraguayensis*) and Guarana paste (formed from the ripe dark-brown seeds of *Paullinia sorbilis* or *Paullinia cupana*) are also extensively used in Brazil, Paraguay, Virginia, Carolina, etc., in South America even to this day. With the exception of some of the Mohammedan countries, the use of coffee is not nearly so extensive as that of tea, perhaps because of its higher price. In India very little coffee is taken, and with the exception of Southern India the use of coffee is practically unknown among the indigenous population.

Habitual Use of Caffeine:—It is indeed interesting to note in what mysterious way or with the aid of what instinct, man has been able to select from the immense vegetable world, the plant most suitable and desirable for his purposes. Quite different plants have been discovered in three different continents of the world, America, Africa, and Asia which are all

used as beverages and which are all characterised by the sole and all important feature, a content of caffeine. Lewin (1931) in his book 'Phantastica' remarks, "We know in fact that man has attached himself tenaciously to the caffeine plants and their derivatives and daily satisfies the desire they have inspired in him. And this for good reasons. An abyss separates the properties and action of these plants from those of the other substances described in this work. Consciousness is not obscured by a veil of dimness or darkness, the individual is not degraded by the destruction of his free will to animal instincts, and the soul and mental powers are not excited to the inward perception of phantasms. The caffeine plants exercise an exciting action on the brain without giving rise to any mentally or physically painful impressions. All these facts assign a particular place to these substances." It is well known that moderate quantities of tea and coffee are not only not harmful but are even beneficial. When taken in excess they produce harmful effects.

The Tea and Coffee Resources of India

Average samples of tea leaves contain from 2.5 to 3% of caffeine, though some varieties may contain as much as 4%. Coffee beans, in which caffeine occurs partly free and partly in combination, rarely contain more than 1.5%. Maté contains from 1 to 2%, Guarana paste from 3 to 4% and Kola about 3% of caffeine. We will confine ourselves mainly to the consideration of tea, as caffeine is obtained industrially almost entirely from this product. Though caffeine is also obtained in the manufacture of 'caffeine-free' coffee and has been prepared synthetically from urea and similar bodies, it is not obtained in an economically profitable yield.

In India, both tea and coffee plants grow luxuriantly. Coffee is grown principally in Madras, Coorg, Mysore, Travancore and Cochin. The total area under cultivation was 160,800 acres in 1929 with an estimated yield of 2,776,700 lbs. of cured coffee. This is a very satisfactory figure but cannot be compared with the huge production of tea in India. Almost all the tea consumed in foreign countries is derived from India, Ceylon,

the East Indies, and the Far East. With the rapid increase in consumption of tea in England (Annual consumption of tea in 1840 amounted to 1.2 lbs. per head and at the close of the century it was 6.07 lbs. per head) and the Continent, an expanding market was available and the tea-growing countries in India and the East extended their resources to meet the ever-increasing demand. China remained the most important tea-producing country for a long time but gradually India came into the field and through the efforts of the British tea planters, the Indian tea industry progressed by leaps and bounds. The extent, to which the trade has progressed, can be judged from the fact that in 1703 the import into England was somewhere about 100,000 lbs. and in the year of the battle of Trafalgar, it reached 7.5 million pounds and at present it is grown in many provinces in India, *e.g.*, Assam, Bengal, Bihar and Orissa, the United Provinces, the Punjab, Madras, Coorg, and the States of Tipperah (Bengal), Travancore, Cochin and Mysore. A high rainfall is essential for its growth. The seeds are sown between November and March and the seedlings are transplanted when they are at least 6 months old. The crop is plucked from May to December in Northern India and from January to December in Southern India. The total area in acres under tea cultivation has been estimated in 1929 at 788,800 acres of which 429,600 acres fall within the boundaries of Assam and 203,200 acres within Bengal. Fairly large areas are also under cultivation in Madras and Travancore. Indeed it may be said without exaggeration that India is the largest tea-growing country in the world. Ceylon comes next in importance. Judging from the export figures, it appears that India exports more tea than all other tea-trading countries. This will be evident from the table below showing the world exports of tea in two recent years 1928 and 1929 (in million pounds).

India	355.5	(1928)	380.4	(1929)
Ceylon	236.7	,,	251.5	,,
Java & Sumatra	153.5	,,	161.3	,,
China & Formosa	33.4	,,	32.8	,,
China (black & green) ...	76.8	,,	73.0	,,
Total from other foreign countries	263.7	,,	267.1	,,

Possibilities of Caffeine Manufacture in India

The tea and coffee resources of India being so well developed, it is indeed disappointing that the alkaloid caffeine is not manufactured here and that the country is completely dependent on foreign manufacturers. Caffeine cannot be economically manufactured from coffee but it can be manufactured from tea. Further, it is not necessary to use good tea suitable for human consumption in the manufacture of caffeine. In the preparation of finished tea for the market, a large amount of fluff and sweepings are left over. These are known as 'tea-wastes' and are unfit for human consumption. Tea waste is available at a cheap price and caffeine is usually manufactured from it. It has been estimated that the yield of tea waste and sweepings in the manufacture of finished tea amount to 1-5% on an average, though this may vary slightly in different districts in India. According to the report of the Indian Tea Cess Committee, India exported about 382,594,835 lbs. of tea by sea and land in the year 1929-30. In the preparation of this amount of finished tea, 3,825,948 lbs. of tea waste would, therefore, be available. If caffeine is produced from this tea waste nearly 57,388 lbs. could be produced, even if the alkaloid available from 50 to 60 million pounds of tea used in India is not taken into consideration. In large scale extraction about 1.5% of caffeine could be recovered from tea waste. This would bring in nearly 6.5 to 8 lacs of rupees at the present wholesale price of caffeine alkaloid in the Calcutta market (Rs. 10/-, Rs. 12/- per pound).

In actual practice, however, many difficulties have to be faced. Though there is no law which interferes in any way with dealings in tea waste in India, it is not sold by the Indian Tea Association to the public at large but only to reliable parties in view of the fact that tea waste and sweepings constantly find their way into the bazar as adulterants of good tea to the detriment of the tea industry generally. With a view to avoiding adulteration of good tea with worthless stuff, the Indian Tea Association usually exports the tea waste to foreign countries for the manufacture of caffeine. In the year 1927-28, 4,114,638

lbs. of tea waste were exported to the value of Rs. 4,41,671. If tea waste is sold to the Indian manufacturers at the price at which it is exported (1.7 annas per lb.) it should be possible to manufacture caffeine economically. Caffeine was actually manufactured some time ago on an industrial scale in Calcutta by a firm of pharmaceutical chemists, but it is reported that the production has since been discontinued. The difficulty seems to be that the price for tea waste and tea dust charged by the tea producers here is too high for the economic production of caffeine. Besides this, India has to depend entirely on foreign solvents. In the manufacture of caffeine, alcohol or benzene is employed in fairly large quantities and the high price charged by the importers is a great handicap to the Indian manufacturer. Furthermore, the demand for caffeine and its salt in India is not large enough for a large-scale production of the drug. To develop this industry, India should find some foreign market for the sale of the alkaloid. In spite of these difficulties, there appears to be no reason why India, the largest tea-growing country on the globe, should not produce her own caffeine. From theoretical considerations, she should hold the key to the caffeine industry of the world.

References :—

(1) Wehmer, 1931, *Die Pflanzenstoffe*; (2) Leach, 1926, *Food and Drug Analysis*, 4th edition; (3) Department of Commercial Intelligence and Statistics, 1929, *Estimates of area and yield of principal crops in India*; (4) United Planters' Association of Southern India, 1929, *Report*; (5) Indian Tea Association, 1929, *Report*; (6) Indian Tea Cess Committee, 1929, *Report*; (7) Imperial Economic Committee on Empire Products, 1928, *Report*; (8) Lewin, L., 1931, *Phantastica*; (9) Watson, Sheth and Sudborough, 1922. *Journ. Ind. Inst. Sci.* Vol. 5, p. 177.

CANNABIS SATIVA (N.O. Urticaceæ)

Cannabis indica

VERN.—Sans.—*Ganjika, Bhanga, Hursini* ; Hind. & Beng.—*Ganja, Bhang, Charas* ; Pers.—*Darakte-bang* ; Arab.—*Kinnab*.

The hemp plant originally was a native of western and central Asia, but it is now widely-distributed and largely culti-

vated in temperate and tropical countries. It is remarkable that hemp grown in India is of a very different character from that grown in Europe and other places, and that is why it was given the distinctive name of *C. indica* which has now been abandoned. It grows wild all over the Himalayas. There are no botanical characters to separate the Indian plant from *C. sativa*. Hemp, therefore, as a fibre-yielding plant is in no way different from hemp as a narcotic-producing one. Some authorities have, however, mentioned certain differences in the seeds of *C. indica* and common hemp, thereby implying that the two plants may be distinct varieties. There is no doubt, however, that the female plant cultivated for fibre in Kumaon and other places yields considerable quantities of *charas* and it is sometimes smoked as *ganja*. The dried flowering or fruiting tops of the pistillate plant *Cannabis sativa* are used in medicine. The drug obtained in the European commerce has a lot of moisture in it.

Preparations of *Cannabis indica* have been in use as intoxicants in Asiatic countries and Africa from time immemorial. Bhang, ganja, charas, etc., are habitually indulged in by many millions of mankind. Its narcotic and anodyne properties were appreciated by the western medical men in the early parts of the last century and it was made official in the British and United States Pharmacopœias. The plant is met with in various parts of the world, but in few other places does it attain the same degree of pharmacological activity as it does in India. The female plant is taller than the male, and its foliage is darker and more luxuriant ; it takes from 5 to 6 weeks longer to ripen. The height of the plant, however, varies greatly with season, soil and manuring; in some districts it varies from 3 to 8 feet, but in other places, it is not unusual to see them from 8 to 16 feet in height.

According to Prain, the hemp plant is not indigenous to India, but, having reached India as a fibre-yielding species, the plant developed the narcotic property for which it is now cultivated. Watt is not so decided on this point. The plant has been found wild to the south of the Caspian Sea, in Siberia and in the desert of Kirghiz. It also grows in a state of nature in central and southern Russia and to the south of the Caucasus. The plant has been known in China since the 6th century B.C. and is possibly indigenous on the lower mountain hills. It

grows wild in Persia. In India it is found growing wild on the western Himalayas and Kashmir and is supposed to be acclimatised to the plains of India. The internal relation of various Asiatic names to Sanskrit 'Bhanga' seem to fix its ancestral home somewhere in Central Asia. It may be mentioned here that there are other fibre plants, *Crotalaria juncea* and *Hibiscus cannabinus*—products growing under the name of hemp, but these cannot be regarded as true hemp.

Spontaneous and Wild Growth of Hemp Plant:—*Cannabis sativa* grows wild throughout the Himalayas from Kashmir to east of Assam. It disappears at a higher altitude than 10,000 ft. It extends down the southern slopes of the mountains, and into the Punjab and Gangetic plains to a limited distance. It is found in the hill tracts of Assam and spreads along the mountain tracts of East Bengal. The southern boundary of the area runs approximately from Peshawar through the middle of the Punjab and the United Provinces and then follows the course of the Ganges. In this region, the plant propagates itself, but it is possible that the growth on the lower slopes of the Himalayas and in the Terai springs to a large extent from seeds carried down from the mountains. In the populous parts of the sub-Himalayan tracts, the wild growth is kept up in great measure by fresh importation of seed from the ganja and bhang which are consumed by the people. The plant appears to be very hardy when it is once well established, but it is clear from the distribution of the wild growth in India that the conditions of soil and climate under which it can attain full growth are limited. The soil need not be rich, but it should be well-drained and permeable.

Cultivation of Hemp Plant:—The hemp plant has never been cultivated in India to any great extent. The Hemp Drugs Commission (1892-93) obtained statistics of the areas under cultivation and found that after deducting the fibre cultivation, which yields but little of the narcotic drugs, the total area under cultivation could hardly exceed 6,000 acres. Since then there has been considerable decrease, owing to the limitation put by the League of Nations in the production of narcotic drugs. The figures obtained for 1929-30 show hardly 1000 acres under cultivation.

Chemical Composition :—The first important work on the chemistry of charas was that of Wood, Spivey and Easterfield (1896). Working with a sample from the U.P., they found the following important constituents:—(1) a terpene $C_{10}H_{16}$, B.P. 165-175°, yield about 1.5% ; (2) a sesqui-terpene $C_{15}H_{24}$, B.P. 258-259°, yield about 1.75% ; (3) a small amount of a paraffin hydrocarbon $C_{29}H_{60}$ M.P. 64° ; and (4) a toxic red oil or resin, $C_{18}H_{24}0_2$, termed *Cannabinol,* B.P. 265°/20 m.m., yield about 33%. The red oil set to a semi-solid mass, insoluble in water but dissolving easily in alcohol, ether, benzene, glacial acetic acid and organic solvents generally. It gave a monoacetyl and a monobenzoyl derivative, proving the presence of a hydroxyl group, and was therefore termed Cannabinol. It was considered by the authors to be the active principle of the drug and Marshall (1897) showed by physiological experiments on himself and on others that it was so. Later (1899) they showed that the cannabinol isolated by them was a mixture of at least two compounds having similar physical characters. They have retained the name Cannabinol for the pure compound $C_{21}H_{26}0_2$ (obtained by hydrolysing the crystalline acetyl derivative of melting point 75°) whilst the original crude cannabinol is probably a mixture of this and one or more compounds of lower molecular weight. The authors also described a series of derivatives and decomposition products of pure cannabinol which throw some light on the probable constitution of the compound. Bauer (1927) concluded that cannabinol is not an ester, acid, aldehyde, ketone or phenol but is probably of the nature of a *polyterpin.* Cahn (1930) suggested the correct formula for cannabinolactone, a decomposition product of cannabinol isolated by Wood, Spivey and Easterfield.

Other investigators have obtained apparently constant boiling resins and, although these yielded only oily derivatives, they have claimed homogeneity for each product, appropriated the name cannabinol, and variously assigned to it the formulæ $C_{20}H_{30}0_2$ (Casparis 1926 ; Bergel, 1930) and $C_{21}H_{30}0_2$ (Fränkel, 1903 ; Czerkis , 1907).

The most recent work of Cahn (1931) was carried out with several different samples of 'hashish' of uncertain origin, all of

which gave similar results and these were confirmed with a *Cannabis sativa* resin of known Indian origin. His work and that of Wood, Spivey and Easterfield have shown that the apparent constancy of boiling point cannot be held to prove the homogeneity of these resins, and that the resins of Fränkel, Czerkis, Casperis and Bergel were all mixtures. The name 'Cannabinol' $C_{21}H_{26}O_{27}$ should be applied only to the substance obtained from the acetyl derivative of melting point 75° and the apparently constant boiling resin should be termed 'Crude cannabinol'.

Use of Hemp Drugs for Euphoric Purposes

C. sativa and its products are used for narcotic purposes in India in two different ways:—

1. By smoking 2. By taking internally

Preparations Used for Smoking :—1. Ganja is known in Hindustani, Bengali, Marhatti and Punjabi as *Ganja*, in Tamil *Ganja-yala*, in Telugu *Bangi-aku*. *Ganja* consists of the dried flowering tops of the cultivated hemp plants which have become covered with the exuded resin in consequence of having been unable to set seeds freely. It is also said to be prepared from a particular variety of the wild plant known as the *ganja plant* but this is doubtful. Ganja has a rusty green colour and a characteristic odour.

Smoking of Ganja :—Most of the ganja produced is used up for smoking, though a small quantity is also used for taking internally in certain parts of India, *e.g.*, Puri, Madras. The process of preparing the drug for smoking is simple. A small quantity of the drug, usually about 1 to 2 grams, is taken and moistened with a little water and rubbed in the palm of the left hand with the right thumb for a short time till the stuff becomes sticky. It is then mixed with a little ordinary tobacco and smoked in a *chillam*. The intoxicating quality of the drug is said to increase with the length of the time spent on rubbing it but this is doubtful. *Ganja* is largely used by Hindu sadhus such as 'Jogis,' 'Bairagis' and Mohammedan fakirs and mendicants as a class. Poor classes and menials of all descriptions, such as syces, grasscutters, sweepers, weavers, day labourers, etc., smoke it. It is also used by criminals to drug people with a view to making them insensible and robbing them. For this purpose *ganja* is mixed with the seeds of black dhatura and sugar and a sweet is made out of these.

Charas :—Charas is the name given to the resinous matters which form the active principle when collected separately. It is really the concentrated resin exudate collected from the leaves and flowering tops or agglutinated spikes of *C. sativa*. There is practically no evidence

that charas is prepared in the plains. Various methods of preparing charas in this country have been described. Sometimes men dressed in leather suits or jackets pass through the field of *C. sativa* rubbing and crushing roughly against the plants early in the morning just after sunrise and when a fall of dew has taken place. The resinous matter, which sticks on, is then scraped off and forms the ganja resin of commerce. In Kulu and the Hill States, the flower heads are said to be rubbed between the hands and the accumulated resin is scraped off. The operation is also said to be done by treading the plant with the feet. Sometimes the flowering twigs are simply beaten over a piece of cloth and the greyish white powder which falls is collected.

In Yarkand *C. sativa* flourishes and is said to be cultivated on a large scale in Bokhara and other places in Turkestan. The Russians, however, prohibited its cultivation many years ago within their territory so that the supplies are almost entirely obtained from Yarkand territory. The charas imported to India all comes through Leh in Kashmir State and a certain amount also comes through Kulu. A depot for storing the drug has been established in Leh. According to estimates of the excise authorities, the total import amounted to 5,000 maunds in 1892-93, but this was an exceptional year. Usually 3,000 to 4,000 maunds are imported and the quantity has fallen considerably of late years.

Bhang :—*Bhang, Siddhi, Subji* or *Patti* is the dried leaves of *C. sativa*, whether male or female, and whether cultivated or uncultivated. The term has also been sometimes made to include the female flower heads as well as the leaves of the plant, and the green leaves as well as dry leaves. It is also probable that male flower heads must also enter into it as the methods of preparing bhang are very crude, the plant being simply dried and the leaves being separated by beating it against a block of wood or hard ground. It must, however, be remembered that the male flowers are not more narcotic in their action than the leaves, unlike the female flower heads.

'Bhang' is commonly the name given to the drink made out of *sabji;* ganja pounded up and made into a drink, as is done in case of Garhjat ganja in Puri, also is called bhang. For this reason in many parts of India especially in the South and West the distinction between ganja and bhang is lost. Bhang here is the name given to the most simple style of consumption, *viz.*, pounding and drinking, which in the evolution of its narcotic use must have preceded smoking. Although bhang is a more comprehensive term and often includes ganja in the North, in South India ganja is a more general term, and in some places is made to include even bhang, the latter term being quite unknown there.

Bhang is prepared from both the uncultivated plant and a small quantity from cultivated plant. The plant is cut and is alternately exposed to sun and dew. When the leaves are dried they are pressed

and stored in earthenware vessels. Bhang is also the name given to the refuse of the treading floor when ganja is prepared.

The usual time for gathering leaves for preparation of bhang varies with the locality in which it is grown, but it is usually in the months of May and June in lower altitudes and June and July in higher places. The bhang obtained from some localities is regarded as superior to that obtained from others. There is no evidence to show that the cultivated plant yields a superior quality of the drug.

The use of hemp drugs to produce euphoria is very wide-spread in Asia and Africa. In Egypt the inhabitants at the present time smoke hashish, a preparation made from *C. sativa.* The drug is also used to a great extent in North Africa, from Tripoli to Morocco and in these parts it is preferred to opium. The whole of Algeria is full of hashish smokers. The habit as a rule is prevalent among the poorer classes such as camel and donkey drivers. On the west coast of Africa the passion for the drug exists in isolated parts, but is more apparent among the Congo Negroes wherever they live, *e.g.*, Liberia. They cultivate it and smoke the fresh or dried leaves in pipes in which a piece of glowing charcoal is placed. Along Loango coast, hemp is smoked in form of leaves and seeds in water-pipes. Further south, hemp smoking has become a popular custom among the Hottentots, Bushmen, and Kaffirs. It is smoked either alone or with tobacco. Hemp smoking is also greatly in vogue in East Africa, with the exception of the territory between the lakes. They smoke the hemp which they themselves cultivate.

The cultivation of hemp formerly flourished greatly in Turkey, but was prohibited towards the end of the last century, though this did not prevent its clandestine use. A preparation of hemp called *Esrar* (secret) is smoked together with tobacco. Hemp in other forms is chewed. In Syria, hemp is cultivated and the resin is carefully collected. In Damascus there are many dens where opium and hashish are smoked and so also in Persia. Uzbeks and Tartars are addicted to hemp.

In India the use of hemp is wide-spread. In Bengal and Behar ganja is largely smoked and bhang is used to a small extent; in the United Provinces ganja, charas and bhang are all largely used; in the Punjab charas and bhang are to a great

extent consumed ; in Sindh bhang is largely consumed and ganja and charas are used to a lesser extent ; in Bombay, and Madras Presidencies and the Central Provinces ganja is largely consumed, bhang to a lesser extent and charas very little. The use of bhang in some parts is combined with religious and social observances. The conclusions of the Hemp Drugs Commission, India (1893-94), were that the moderate use of hemp drug appeared to cause no appreciable physical injury. They also came to the conclusion that moderate use produced no injurious effect on the mind. The popular belief that hemp drugs lead to insanity was not justified by the data before the Commission. The Commission also thought that moderate use produces no moral injury, and there was no adequate ground for believing that it injuriously affected the character of the consumer.

Excessive consumption on the other hand was physically and mentally injurious; it produces and intensifies moral weakness and depravity. Manifest excess leads directly to loss of self-respect and thus to moral degradation.

These observations were made many years ago. The effects of hemp drug habits and their prevalence in India are being systematically investigated by the author and his results will be published in due course.

References :—

(1) *Report, Hemp Drugs Commission*, 1893-94. (2) Lewin L., 1931. *Phantastica*.

CARUM CARUI (N.O. Umbelliferæ)

The Caraway Seed

VERN.—Hind.—*Zira, Shia-jira* ; Beng.—*Jira* ; Tam.—*Shimai-shombu*.

Carum carui grows in north and central Europe, extending to the Caucasus, Persia, Tibet and Siberia. On account of its general importance as a cookery condiment and as a spice, in bakery products and in some kinds of cheese, it is cultivated in various parts of the world, *e.g.* Morocco, Germany, Norway, North America, Holland, Roumania, etc. In India it is cultivated as a cold season crop on the plains and as a

summer crop on the hills, *e.g.*, in Baltistan, Kashmir, Kumaon, Gharwal, Chamba, etc., at an altitude of 9,000 to 12,000 feet.

A valuable essential oil rich in 'carvone' is obtained from the seeds. This oil is colourless or pale yellow with a strong odour and flavour of the fruit. The yield varies from 3.5 per cent. to 5.2 per cent. according as the entire seeds or the coarsely ground seeds are distilled. If it is intended to produce a freely alcohol-soluble oil with especially high 'carvone' content, the whole seed must be used. Oil distilled from wild caraway seeds usually shows a high specific gravity and hence is not much preferred. It is sparingly used in medicine but finds ready employment in flavouring wines, scenting soaps and in perfumery. Cultivation of caraway has made great headway in Holland. The area planted with caraway is gradually on the increase, and in 1926 the harvest yielded about 4,500 tons of seed. In 1927, the total export of caraway figured at 6,000,000 kgs., the chief consuming countries being Germany, the United States, Czechoslovakia, Great Britain, etc. The seeds and the oil derived from them are employed in those countries in the various industries mentioned above. In India, wild caraway would be available in large quantities provided arrangements can be made to collect the harvest together in outlying places. This involves transport charges and is not commercially practicable. Cultivation on a large scale holds out good prospects but, as there are no sister industries where the oil might be utilised, India will have to find a foreign market for her commodity.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Schimmel & Co., 1928, *Report.*

CARUM COPTICUM (N.O. Umbelliferæ)

The Bishop's weed ; *Lovage ; Ajava seeds.*

VERN.—Sans.—*Yamani ;* Hind.—*Ajowan ;* Beng.—*Jowan ;* Bomb.—*Ajwán, Owa ;* Tam.—*Oman ;* Tel.—*Omamu ;* Arab.—*Kamue mulúki ;* Pers.—*Zinián, Nánkhwah.*

CUMINUM CYMINUM (N.O. Umbelliferæ)

Cumin

VERN.—Sans.—*Jiraka* ; Hind.—*Zira* ; Beng.—*Jira* ; Tam.—*Shiragam* ; Tel.—*Jiraka.*

Thymol or thyme camphor is contained in a number of essential oils occurring in many plants, among them being the common thyme or *Thymus vulgaris,* from the leaves and flowering tops of which thymol is commonly distilled. It is also obtained from *T. zygis* (var. *gracilis*). *T. vulgaris* is a small evergreen shrub belonging to the *Labiatæ* family. It is indigenous to Spain, Portugal, France and Italy but is extensively cultivated in other parts of Europe and America, especially in New York State and Germany. The latter country supplies most of the commercial article. Thymol also occurs in the oil from *Monarda punctata* (*Labiatæ*) to the extent of 60 per cent. and also in *Monarda didyma* which are indigenous to North America.

India contains a rich store of thymol. The oil of *Mentha viridis* contains thymol. The seeds from *Carum copticum* are worth special mention in this connection. Ajowan seeds have long been used in Indian practice in diarrhœa, atonic dyspepsia, cholera, colic, flatulence, indigestion, etc. They possess carminative, stimulant, tonic and antispasmodic properties. The water obtained by distillation of the seeds is in extensive use as 'ajowan-ka-arak'. The chief importance of the ajowan seeds, however, is in connection with the production of thymol, which is a very valuable anthelmintic. The seeds yield 2 to 3 per cent. of an essential oil which is official as 'oil of ajowan' and this contains not less than 40 to 50 per cent. of thymol. Crude thymol is sold extensively in India as 'ajowan-ka-phul', though this source was never exploited scientifically before the War.

The plant (*Carum copticum*) grows and is widely cultivated all over India ; it is particularly abundant in and around Indore

and in the Nizam's Dominions. Nearly 7,000 to 8,000 acres of land are under cultivation in the Hyderabad State per year and approximately 1 to 1½ lacs worth of ajowan seeds are stated to be exported every year. The large seeded variety is chiefly used for home consumption and grows in the Kurnool Guntakul district. Thymol can be largely manufactured in this country from seeds obtained from these sources. Besides this, *Cuminum cyminum*, another plant which is abundantly cultivated all over India as a field or garden crop contains a large quantity of cumin oil whose chief constituent is cumic aldehyde, which again can be readily converted artificially into thymol. Cumin is largely used by the people in India as a spice in curries. It is also used in the indigenous medicine as a stimulant and carminative. These sources, if exploited on a commercial scale, present enormous possibilities.

Economic Aspects:—The commercial value of thymol has greatly increased of late years on account of its use as an anthelmintic against hookworm infections and also as an antiseptic, forming part of many proprietary preparations. India can not only supply her own requirements of thymol from the rich store of raw material she possesses, but can also produce enough of surplus store for export. Of late years, Germany has captured the drug markets of the world with thymol obtained by distillation from *T. vulgaris* cultivated there, and by synthesizing it from crude phenol. Synthetic thymol is now finding its way into the market in larger and larger quantities. Previous to 1914, thymol was produced chiefly from natural sources. It is now produced not only from the comparatively cheap meta-cresol, but another source has become available in the form of the ketone 'piperitone'. This can be produced in large quantities from the Australian eucalyptus which can be easily and cheaply grown anywhere in that country. Though thymol occurs in fairly large proportions in the oil of ajowan, no attempt was made before the War to distil the oil from the fruits in India. The exports of ajowan seeds from this country are given in table I.

TABLE I

	Total quantity exported in cwts.	Value of the seed exported in £ sterling
1911-12	15,515	4,583
1912-13	21,650	6,135
1913-14	9,784	2,983
1914-15 . ..	7,368	2,736
1915-16	13,062	4,871
1916-17	11,093	4,304
1917-18	3,990	2,765
1918-19 ...	1,917	2,102

Since 1918, very little seed has been exported.

Before the War, 75 per cent. of this article produced was sent to Germany and there distilled for the manufacture of thymol. The manufacture of this drug, it is understood, has been undertaken at Gwalior in India. An estimate of the production can be formed from a report published in the *Journal of the Indian Institute of Science* in 1921. Table II gives the figures of yield of the oil and thymol on a large scale.

TABLE II

Quantity of Fruit in lbs.	Yield of Oil in lbs.	Yield of Crude Thymol in lbs.
26,076	742.0	321.2
22,227	652.5	269.1
32,380	943.7	370.5

Thymol has also been produced to a large extent in Dhar State, but no information is available whether manufacturing is still going on there. There are, however, difficulties to be encountered in manufacturing the drug in India. Most of the seeds obtainable in the market have apparently been

partially distilled as their oil content is very low. The ajowan oil available averages only 4 to 6 per cent. of thymol and must be evidently de-thymolised. In 1924, experiments were actually conducted under the auspices of the Department of Industries and Commerce, Hyderabad, on the manufacture of thymol from ajowan seeds growing there. It was found that the yield of oil was only 2 per cent. of the weight of the seeds and the yield of thymol crystals was 36.97 per cent. on the weight of the oil. This showed that the quality of the seeds was rather poor in comparison with the foreign seeds. On calculating the actual cost of production, it was found that the price could not compete with the market price of the imported article unless the bye-products of the manufacture, namely, extracted seeds (as fodder or manure), omum water and thymene oil, were also utilised. The manufacture of thymol, from the seeds and oil procured from the market, is fraught with great risks and is not likely to be remunerative.

Attempts were made during the War to cultivate this plant in other parts of the world. A sample of seeds from the Seychelles gave on analysis 9 per cent. of the oil and from Montserrat 3.1 per cent. of oil containing 39 and 54 per cent. of thymol respectively. These figures show a much higher yield than that obtained from the Indian fruit (about 2.85 to 2.91 per cent.). More attention should, therefore, be paid to the proper cultivation of ajowan seeds on scientific lines in suitable parts of India. If this is not done the trade in this drug is likely to be seriously affected. Unless the quality of the seeds is improved, India will not be able to compete with other countries growing a superior quality of seeds. In view of the increasing production of synthetic thymol, it is doubtful if this industry will ever be successful.

References :—

(1) Chopra & Chandler, 1928, *Anthelmintics and their Uses in Medical and Veterinary Practice;* (2) Finnemore, 1926, *The Essential Oils;* (3) Lakhani, Sudborough and Watson, *Jour. Ind. Inst. Sci.*, 1921, Vol. 4, p. 59; (4) Inuganti, Bhate and Habib Hasan, 1924, *Bulletin, Dept. of Industries and Commerce*, Nizam Govt. publication; (5) Chopra & Mukerjee, 1932, *Ind. Med. Gaz.*, May.

CARYOPHYLLUS AROMATICUS (N.O. Myrtaceæ)

Eugenia caryophyllata

Cloves

VERN.—Sans. & Beng.—*Lavanga* ; Hind.—*Long, Laung* ; Bomb.—*Lavang* ; Tam.—*Kirambu.*

Caryophyllus aromaticus is a native of the Molucca islands and is cultivated in Zanzibar, Pemba, the Amboyna islands, Penang, Madagascar and to a lesser degree in the Seychelles, Reunion, Mauritius and Ceylon. It has also been cultivated in Southern India but has never been grown on a large scale. The flower buds of this plant yield the cloves of commerce. These are picked when the fleshy receptacle, which is at first green, has acquired a crimson colour. At this period of its growth, the clove is richest in oil.

The dried flower buds (the cloves of commerce) are aromatic, stimulant, and carminative; they are used in various forms of gastric irritability and dyspepsia. In the Hindu and Mohammedan medicine, cloves are used in various conditions either in the form of a powder or a decoction made from them. The oil distilled from the flower buds is commonly used nowadays in Western medicine. It imparts a delicate aroma to the preparations and helps to disguise the taste of many obnoxious preparations. It easily mixes with grease, soap and spirit and is extensively made use of in the manufacture of perfumery. It is largely employed in the manufacture of 'Vanillin' and huge quantities of clove oil are annually imported to the continent. The demand for cloves and clove oil has increased greatly within recent years in Java, Sumatra, Borneo, China, Japan and India for the purpose of aromatising cigarette tobacco. As a spice, it is perhaps used all over the world.

Ninety per cent. of the world's supply of cloves is obtained from the two islands, Zanzibar and Pemba, where it was introduced about the year 1818 and where it forms the chief industry. The area of clove cultivation in Zanzibar and

Pemba during the year 1919 was estimated at 52,000 acres with nearly 5,000,000 trees. The cultivation has steadily increased since then. An idea of the extent of the clove crops may be gained from the figures for the 1925-26 harvest which amounted to between 6,500 to 7,000 tons in Pemba and between 3,500 to 4,500 tons in Zanzibar. In the first six months from January to June 1927, for which figures are available, 1,450 tons were exported from Zanzibar alone. Of this, India took 58 per cent., the United Kingdom 16 per cent., and the United States 10 per cent. This shows that India is one of the most important consumers of cloves from outside.

Very little is known regarding the present position of the clove industry in South India, but it appears probable that no systematic attempts have been made to cultivate it on scientific lines. The clove trees ought to flourish very well in the vicinity of the coast provided they are protected from too strong sea-winds. Though the prospects of the clove industry have been greatly affected by the appearance in the market of the clove oil substitutes, the opinion is held by many experts that even at present the production of cloves is still profitable to the owners.

References :—

(1) Finnemore, 1926, *The Essential Oils*; (2) Schimmel & Co., 1928, *Report*.

CASSIA ANGUSTIFOLIA (N.O. Leguminosæ)

Indian Senna

VERN.—Hind.—*Hindi-sana* ; Beng.—*Sona-mukhi* ; Arab.—*Sana-e-hindi* ; Tam.—*Nilavakai*.

Senna leaves are well-known in the Western medicine for their laxative and purgative effects. The preparations 'confectio sennæ' and 'pulv. glycyrrhizæ Co.' are two of the most popular remedies of the Pharmacopœia. The activity of the drug is due to cathartic acid ; the other constituents are emodin (trioxy-methyl-anthraquinone), chrysophanic acid, etc. These are contained in the leaves though the pods also possess

them; the legumes are said to be more active when green. The drug has been known to the Arabs for many centuries and it is believed that it was introduced into Indian and European medicine through them. Even to-day the Arab physicians extol the merits of senna as a purgative and as a cordial when mixed with suitable drugs such as violets (Banafsha).

Two varieties of Cassia have been recognised by the British Pharmacopœia, *C. acutifolia,* which comes from Alexandria and is also derived from the wild plant met with in Southern Arabia, and *C. angustifolia.* The latter variety grows fairly extensively in Tinnevelly and recently its cultivation has been extended to Madura and Trichinopoly in the Madras Presidency and Poona in Bombay. Tinnevelly senna used to be of a much better quality than the Arabian article. The leaves are larger, being 1″ to 2″ long, of a yellowish green colour, glabrous on the under side with short depressed hairs. Owing to faulty cultivation, the quality has deteriorated of late years. A third variety, *C. obovata,* which grows in the Deccan is sold as 'country senna'. This was used as an adulterant to ordinary senna but was not recognised in the Pharmacopœia.

The yield of Tinnevelly senna is estimated to be 1,000 lbs. of leaves per acre in ordinary soil. It is said that by careful cultivation in moderately rich loamy soil the out-turn might be doubled. Almost all the senna leaves produced in India are exported to foreign countries and the major portion is transported to the London market. It would appear from the records that India has enjoyed the benefit of the export trade for a long time. As early as 1887-88 according to the figures given by Watt, the total exports from India of locally grown senna came to 21,376 cwt. valued at Rs. 3,18,869. A glance at the table of drugs and medicines for five years from 1924-25 to 1928-29 will show that on an average about 48,291 cwt. of senna leaves priced at Rs. 9,35,170 were exported from India. The quantity shown in the export returns does not truly indicate the Indian produce as a considerable quantity of Aden senna is said to be imported into India *via* the inland route. Although it is difficult to make a correct estimate of the actual

quantity of Indian senna exported, it is certain that the Tinnevelly senna forms the major portion of the export. The trade in senna is believed to leave a handsome margin of profit and more attention towards the cultivation of this drug may be a paying proposition. Alexandrian senna (*C. acutifolia*) has also been cultivated in India and a good quality of leaf can be produced from this variety.

References :—

(1) Dutt, 1928, *Commercial Drugs of India;* (3) *Sea-borne trade statistics of British India.* Year ending March 31, 1930; (3) Tutin, F., 1913, *J. C. S. Trans.*, p. 2,006.

CHENOPODIUM AMBROSOIDES (N.O. Chenopodiaceæ)
CHENOPODIUM BOTRYS (N.O. Chenopodiaceæ)

Mexican Tea, Jerusalem Oak.

Chenopodium (American wormseed) is one of the most widely used anthelmintics at the present time. It was used by the American Indians in the days of Columbus and in South America infusions made from leaves and seeds have been used as a household remedy against intestinal parasites for a long time. Baumler and Fribourg introduced the drug into Europe in 1881 for the treatment of hookworm disease but their results were not encouraging. The oil was originally used as a remedy against ascarides but was not popular on account of the toxic and sometimes fatal effects produced in some cases. Schüffner and Vervoort (1913) tried it against hookworms in Sumatra in 3 c.c. doses with castor oil and chloroform, and obtained results superior to those obtained with thymol, beta-naphthol, etc. From this time on, the drug came rapidly into use and received further impetus during the Great War when the supply of anthelmintic remedies such as santonin and thymol decreased. It was extensively tried by various workers and proved a very valuable anthelmintic against many forms of intestinal parasites.

Oil of chenopodium is obtained principally from *Chenopodium ambrosoides*, var. *anthelminticum* or American wormseed,

commonly known as 'Mexican tea'. It is an annual or perennial herb belonging to the *Chenopodiaceæ* or goose-foot family. It is a native of Central America and the West Indies but grows wild in many parts of the United States from New England to Florida and California. The plant flowers from July to September and the fruits ripen in the autumn. The oil is distilled from the seeds and the half dried, aerial parts of *C. ambrosoides*. At one time the fruit was official in the U. S. Pharmacopœia but it has been discarded. The fruit from which the oil is expressed is somewhat globular, frequently more or less compressed, with a thin greyish brown pericarp. The seeds are reddish, brown or black, kidney shaped and shiny, and have a strong eucalyptus like aromatic odour and a bitter and pungent taste. A large trade in chenopodium seeds has existed in America for a long time. Nowadays chenopodium seeds are very seldom exported as the oil is distilled on a large scale in Baltimore (Baltimore oil) and in Illinois (Western oil).

Chemical Composition and Properties :—The active principle of chenopodium is a volatile oil which, like most of the substances of this class, is a mixture of various constitutents. The oil has no definite boiling point and, when it is heated to 100°C in the air, it explodes with great violence. Different specimens of the oil differ much in their physical characters; the colour may vary from pale yellow to bright golden yellow. The toxicity of different stocks also varies considerably. The chemical composition of the oil has been extensively studied and though there is diversity of opinion regarding minor details the following composition may be taken as the standard :—

1. *Ascaridole* varying from 45 to 70 per cent. of the total oil in different samples. It has a definite chemical composition $C_{10}H_{16}O_2$.
2. Small portions of an isomer of ascaridole, the *glycol anhydride* or its corresponding hydrate, in proportions of 5 per cent. or more of the total oil.
3. A mixture of various liquid *hydrocarbons*, containing cymene, α-turpinene, a new lævo-turpene, etc., making about 30 per cent. of the total.
4. Traces of lower fatty acids, chiefly butyric acid, and about 0.5 per cent. of methyl salicylate.

Other Sources of Chenopodium :—Though chenopodium is indigenous to Central America, it is found growing in a state of nature in the East Indies and in India. In the Philippines as

many as 50 species grow but only two varieties have so far yielded oil of medicinal value. In Sumatra and several other places of the Dutch East Indies, chenopodium has been seen. In India 6 or 7 species are known to occur. It is interesting to note that chenopodium can also be cultivated in areas, where it is not indigenous, with satisfactory results. This has been done on a large scale near Weston in America where a belt of land 15 miles long and 4 miles broad is under cultivation with an average annual production of 10,000 to 40,000 lbs. per 20 acres. At Deli in Sumatra and in Java the plant is grown successfully and the oil is also distilled but it differs slightly in composition from the standard American oil.

Indian Varieties:—*Chenopodium ambrosoides* is common in many parts of Bengal, Sylhet, the Deccan, Coimbatore, etc. *Chenopodium botrys* is found in the temperate Himalayas from Kashmir to Sikkim at altitudes from 4,000 to 10,000 ft. Several other varieties, *e.g.*, *C. blitum*, *C. album* (known in Bengal as 'Bathu-sag') grow both in the hills and in the plains, and are available plentifully near Calcutta. All these varieties of chenopodium, however, do not yield the therapeutically active oil. In view of the importance of the drug, experimental cultivation was started at Mungpoo in the Darjeeling district and also in the Bangalore gardens in Mysore State. It was recommended in the report of the Director of Botanical Survey in India some years ago that the seeds should be sown thinly in a seed-bed in March and transplanted 18 inches apart in all directions. *C. ambrosoides* which was planted grew to a gigantic size at Mungpoo and seeded well but the seeds yielded only 0.48 per cent. of oil in contradistinction to the expected yield of 3 per cent. For several reasons the cultivation of this variety has not been proved to be a commercial success in Bengal and has been discontinued.

The Indian and the American Oil:—The Indian chenopodium oil—both from *C. ambrosoides* and *C. anthelminticum*—was examined by Henry and Paget at the Wellcome Bureau of Scientific Research. The yield of the oil according to their estimation was lower. The percentage of oil yield from *C. ambrosoides* was 0.17, and from *C. anthelmintica* 0.24.

The oil expressed from the Indian seeds was found to be lighter in colour, and had an odour somewhat different from that of the American wormseed oil derived from *C. ambrosoides*, var. *anthelminticum*.

The constants of the Indian oil as compared with those of American wormseed oil are as follows :—

Nature of Oil	Sp. gr. at 15°C	Sp. rotation
C. ambrosoides (Indian)	.. 0.9399	+0.07°
C. anthelminticum ,,	... 0.9080	−9.6°
American Wormseed Oil	... 0.9669	−5.6°

From the results of the fractional distillation, the composition of the mixed Indian oil as compared with that of American wormseed oil is approximately as follows :—

	Mixed Indian Oil per cent.	American Wormseed Oil per cent.
Hydrocarbons	... 45—50	30—40
α-terpinene ...	... Nil	5
p-cymene .	... 25	15
Chenopodium terpene	.. —	10
Ascaridole ..	... 46	65
Residue ...	.. 4	5

It will be seen from the above that Indian chenopodium oil differs from good American chenopodium oil in containing less of the active principle, ascaridole, *viz.*, only about 46 per cent. in place of 65 per cent. or more. Another difference lies in the nature of the hydrocarbons present. The American oil contains about 30 per cent. of this fraction of which about half is cymene and the other half a mixture of terpinene and a laevo-rotatory terpene. The hydrocarbon fraction of the Indian oil on the contrary is p-cymene with a small amount of dextro-rotatory terpene. The specifications of the United States Pharmacopœia are that the oil shall have a specific gravity of 0.955 to 0.980 at 25°C, shall be soluble in 8 volumes of 70 per cent. alcohol and shall have an optical rotation between −40° and −10° in a 100 mm. tube at 25°C. The mixed Indian oil therefore obviously falls short of these specifications.

Economic Aspects :—In view of the differences between the two specimens of oil as outlined above, the Indian oil may be considered to be very much inferior. The results achieved

so far clinically with the Indian oil are, however, said to have been satisfactory. It was tried by Chandler with encouraging results in hookworm disease and roundworm infestations. It will, therefore, be worth while to investigate its further possibilities. Experiments carried out in America definitely show that it is possible to improve the quality of the oil by intensive cultivation. Poor cultivation, without proper attention towards sowing and without the liberal use of fertilisers, results in a small yield. These details could be easily attended to in India. Further, in the light of work carried out by W. A. Konantz, Chief of Research Department, Quincy, Illinois, it seems probable that the quality and yield of oil are largely due to faulty methods of distillation. Nelson has laid stress on the method of distillation, stating that the chief active ingredient was unstable and was decomposed gradually on boiling with water. Consequently he suggested that the distillation should be carried on rapidly with steam at a higher pressure, the condenser kept warm and the warm distillation water separating from the oil in the receiver discarded. Russell stated that "the method of distillation is a factor which causes great changes in the oils" and that "with rapid distillation, that is with a good flow of steam, an oil was secured which passed all of the United States Pharmacopœia requirements and contained a high percentage of ascaridole". He observed that no difference in yield and specific gravity of the oil occurred when the steam pressure at the distilling retort was 80 to 100 pounds. When the pressure was reduced to 40—60 pounds the specific gravity was lowered. The time of distillation (from appearance of distillate at discharge end of condenser) was 8 to 10 minutes. With a slower method of distillation the specific gravity was reduced. A more careful distillation, therefore, with proper attention to these points is likely to improve the quality of the oil. Though chenopodium has lost much of its ground since the discovery of the anthelmintic properties of carbon tetrachloride by M. Hall in 1921, it is still in great demand. Not only is it used as the alternative or substitute for carbon tetrachloride, but is now also frequently used in combination with it. Soper (1924) called attention to the fact that the proportions of the two

drugs should depend on the nature of the worms harboured. Carbon tetrachloride alone is said to be more effective against pure necator infection and chenopodium for ascaris infections, whereas ankylostoma infections are apparently most readily cured by a combination of the two, with a relatively high proportion of chenopodium. As in India, a mixed parasitic infection is the rule rather than the exception, the demand for chenopodium will always remain. In view of the simplicity of administration and the extreme cheapness of carbon tetrachloride (Rs. 2-8 per pound) as compared with the oil of chenopodium (Rs. 32 per pound) it may not be possible to use it on an extensive scale for mass treatment. It should, however, be remembered that the dose of chenopodium oil when given in combination with carbon tetrachloride is comparatively much smaller (1.0 c.c.) than when given by itself (3.0 c.c.). Maplestone (1931) has obtained much better results by the treatment of ascaris infections with a combination of santonin 5 grains with chenopodium oil 1.0 c.c. in a capsule. In view of these facts there will be sufficient demand to justify the cultivation and production of the oil in India. Apart from its medical use, it is employed largely in veterinary practice in the eradication of intestinal parasites of domestic animals and agricultural cattle. As it is a herb which will practically grow quite well in the plains of India, it would be worth while trying its cultivation in Bengal and some of the neighbouring provinces. Many years ago chenopodium was for some time experimentally grown by a botanist near Port Canning in the 24-Parganas. It has also been grown experimentally in the Benares Hindu University botanical garden. Because chenopodium cultivation has been discontinued by the Government Cinchona Plantation authorities at Mungpoo, there is no reason why it should not be given a trial under more favourable conditions. The results of cultivation of chenopodium in Java, though not encouraging at the beginning, have been very satisfactory as will be seen from a study of the properties of the oil distilled from the seeds there.

Constants of Chenopodium Oil Distilled in Java :—Sp. gr., 0.9662; refractive index, 1.4786; acid value, 0.9; ester value, 9.8; soluble in 5.8 volumes and more, of 70 per cent. alcohol.

This approaches the standard American oil very closely and it has been used in Java in place of the American oil. This fact should encourage those interested in the cultivation of the drug in India.

References :—

(1) Henry, T. A., & Paget, H., 1921, *Trans. Chem. Soc.*, pp. 1714-24; (2) Finnemore, 1926, *The Essential Oils*; (3) Konantz, W. A., 1924, *Journ. Amer. Pharm. Assoc.*, Vol. XII., p. 201; (4) Nelson, 1920, *Journ. Amer. Chem. Soc.*, Vol. 42, p. 1286; (5) Russell, 1922, *Jour. Amer. Pharm. Assoc.*, Vol. II, p. 255; (6) Soper, 1924, *Amer. Jour. Hyg.*, Vol. 4, p. 699; (7) Chopra, R. N., and Chandler, A. C., 1928, *Anthelmintics and their Uses in Medical and Veterinary Practice*; (8) Chopra, R. N., and Mukherjee, B., 1931, *Ind. Med. Gaz.*, Vol. LXVI, Jan.; (9) Maplestone, 1931, *Ind. Med. Gaz.*, Vol. LXVI, Jan.

CINCHONA CORTEX (N.O. Rubiaceæ)

Cinchona bark ; Peruvian bark ; Jesuit's bark.

There is a large demand all over the world for cinchona bark and its alkaloids on account of their value in the treatment of malaria. India, taken as a whole, is probably the most malarious country in the world and naturally requires large quantities of this drug. The genus *Cinchona* comprises about 40 species of ever-green shrubs or trees which grow indigenously on the eastern slopes of the central western chain of the Andes Mountains in South America. They flourish at an altitude of 3,000 to 10,000 feet above the sea level from Costa Rica to the southern borders of Bolivia. Cinchona bark is said to have been introduced into Europe about 1639 A.D. by the Countess of Chinchon. The story is told that while she was in Peru with her husband, who was then Governor, she developed ague and was cured by taking the bark sent to her by the Corrigidor of Loxa. The latter had himself suffered from ague eight years previously and had been cured by it. The Countess was so convinced of the curative effects of this bark that she sent some to her husband's relatives in Spain. From Spain its fame spread to Italy and it was introduced by the Jesuits to France and England about the middle of the 17th century. With the advent of the English it was brought to India and has gradually

replaced all the uncertain remedies used in the indigenous systems in the treatment of malaria. In 1820, the French chemist Pelletier isolated 'quinine', which was then practically the total alkaloids of the bark. The use of the bark became so extensive that fears were entertained that the world's supply of the bark from South America would be exhausted. Attempts were made to transplant some of the species in other countries and in 1852 the Dutch were successful in growing cinchona trees in Java. The Indian Government at once appreciated the possibilities of growing cinchona in India and the beneficial effects which would result from it. In 1860, through the efforts of Sir Clement R. Markham cinchona trees were successfully planted in the Nilgiri hills in Southern India and as they grew well, in 1864 plantations were also started in Mungpoo in the Raughi valley and also in the Karen hills of Burma. The chief species of cinchona which were grown in India are *C. officinalis*, *C. calisaya*, *C. succirubra*, the hybrid *C. robusta* and *C. ledgeriana*, but *C. micrantha*, *C. lancifolia*, *C. cordifolia*, *C. trianæ*, *C. paludiana*, *C. josephiana*, *C. calsopera*, etc., have also been grown.

Of these, *C. succirubra* (red bark) has proved to be the hardiest and the most easily cultivated species. It gives a high yield of total alkaloids—as much as 10 per cent.—but the quinidine and cinchonine contents preponderate over that of quinine. It is largely cultivated in South India at an altitude from 4,500 to 6,000 feet above the sea level. It grows well in the Tomengoo hills in Burma, on the Satpura Range and in the Government plantations in Mungpoo (Sikkim).

Cinchona officinalis (brown bark or pale bark). This variety was grown at an elevation of 1,000 feet in the Nilgiris near Ootacamund and in Ceylon, but was found unsuitable for the climate of Sikkim. The total alkaloidal content in this variety is very large and of late years the quinine yield has considerably increased. It produces the crown bark of commerce.

Cinchona calisaya. This produces the yellow bark and is largely grown in Sikkim at an elevation of 1,500 to 3,000 feet above the sea level. 1,000 gms. of good calisaya bark yield 60 gms. of total alkaloids containing 30 gms. of quinine sulphate. This variety may be said to have also succeeded well under Indian climatic conditions.

C. calisaya var. *ledgeriana*. This variety is largely grown and developed in Java, and yields the most plentiful supply of quinine of all the species. The average quinine content in this variety is about

6 per cent., exceptional samples yielding as much as 10 to 12 per cent. The cultivation of this variety is now being developed in all the Indian plantations and it is gradually replacing *C. succirubra*.

These and some of their hybrids are the important species of cinchona plants grown in India, for the supply of the local demands and the yield of the bark from these sources has been kept up at as high a level as possible in spite of the many difficulties.

Economic Aspects:—In dealing with the economic aspects of the cultivation of cinchona in India, we cannot do better than to summarise the chapter on the quinine policy in the Report of the Drugs Enquiry Committee.

Sources of Supply of Quinine in India:—The annual consumption of quinine in India at present is nearly 200,000 lbs. derived from two sources:—

(*a*) There are in India two State-owned cinchona plantations with factories for the production of quinine. One of the plantations is situated at Mungpoo in the Darjeeling District in Bengal, and the other at Neduvattam, near Ootacamund in the Nilgiris. Besides these there are also plantations in Burma. There were a number of privately owned plantations in the Nilgiris, but these have dwindled during recent years to almost nothing. According to C. C. Calder, Superintendent, Cinchona Cultivation in Bengal, private Indian grown bark, once fairly plentiful, may be said to be a rarity now on the market. When it appears, it is absorbed at prices below world rates because of its inferior quality.

(*b*) As the combined production of quinine by the two factories does not exceed 70,000 lbs. annually, large quantities of this drug have to be imported. The following table shows the amount of quinine derived from the two sources, *i.e.*, manufactured in India and imported into India in lbs.:—

Year		Mungpoo	Madras	Imported	Total
1927-28	...	(46,844	21,688)	113,637	182,169
		68,532			
1928-29	...	(41,368	23,065)	133,795	182,169
		64,433			
1929-30	...	44,140	...	...	...

The reason for the small production of quinine in India is not the export of large quantities of the bark as has been alleged. According to the *Handbook of Commercial Information for India* by C. W. E. Cotton, I.C.S., India exports on the average 6,000,000 lbs. of bark annually chiefly from Southern India ports. In view of the small output of the Indian factories, which are at present not working to their full capacity, and having regard to the fact that large quantities of bark are imported to feed these factories, this statement is very surprising. It is quite true that at one time large quantities of the bark grown by private agencies were exported from India, but lately these figures have fallen considerably. The Cinchona Department buy on Government account practically everything offered and only worthless stuff, which is of no use for quinine manufacture, is ordinarily exported. It is doubtful if as much as 50,000 lbs. is exported annually at the present time.

The reason for the low production of quinine in India is the small area under Cinchona cultivation. The following table gives the figures for the two plantations in India:—

Mungpoo (Bengal)	... 2,877.3 acres.	Actually under plantation though the total area is much bigger.
Neduvattam (Madras)	... 2,035 acres.	

The species of Cinchona grown in the Bengal and Neduvattam plantation are *C. ledgeriana*, *C. succirubra* and a hybrid of these two species *C. robusta*. The area under cultivation undoubtedly is very small for the needs of such a large country as India. That more could be done to produce cinchona alkaloids in India on a much larger scale is admitted by the Cinchona Department.

Quinine Requirements of India:—That quinine is one of the most needed drugs from the point of view of the Indian public is obvious from the fact that it is used in the prophylaxis and treatment of malaria, the most widespread disease in the country. The high incidence of this malady is sufficient ground for a demand for an adequate supply of this valuable drug. It has been estimated that there are in India 100,000,000 untreated sufferers from malaria and a little over 8,000,000 receiving complete or partial treatment. These figures, though not necessarily accurate, are, however, sufficient to show to what an extent the people suffer from that disease. In addition to the high mortality there is the incapacity to individuals, both temporary and permanent. The economic loss and the

consequent penalty which has to be paid by the country as a whole, is tremendous. Figures have not been worked out for India but, according to Andrew Balfour's estimation, the direct loss sustained by the British Empire due to sickness and death caused by malaria amounted to between £52,000,000 and £62,000,000 annually. The share of India might easily be over a half of these amounts.

In view of these facts it will be of interest to see what is the consumption of quinine in India per head as compared with other countries in which a high incidence of malaria occurs. In Italy the consumption is 16 grains per head, in Greece 24 grains, whereas in India it is only 3½ grains. The figures for some of the highly malarious provinces in India show an even lower rate of consumption. For instance, if we examine the different divisions of the Bengal Presidency which is perhaps the most heavily infected area, the consumption per head in Burdwan is 1.07 grains, the Presidency Division 1.31 grains, Rajshahi 1.07 grains, Dacca 1.50 grains, and Chittagong 2.6 grains. These figures speak for themselves and show how inadequate is the supply of quinine in this country.

The next question which arises is "What is the quantity of quinine actually required from the point of view of public health in India?" It has been stated that if each case is treated with 110 grains of quinine, which may be taken as a minimum for the cure of each paroxysm, the demand for hospital and dispensary treatment alone would be 125,000 lbs. a year. Patients do not get as much as they ought to because the cost of quinine is prohibitive. It is estimated that there are 100,000,000 sufferers from malaria who do not attend the hospitals. The potential demand is, therefore, somewhere between 125,000 lbs. and 1,500,000 lbs. When in 1903, the Italian Government made quinine a State industry and cheapened its retail price, consumption in that country enormously increased and malaria mortality was reduced from 15,000 to 3,000 a year.

The Public Health Commissioner with the Government of India says in a recent report, "It may be said that there is no question of the effective treatment of malaria in India until the consumption of quinine approximates to 500,000 lbs." Sir Patrick Hehir has estimated that for India 970,000 lbs. of

quinine would be the minimum amount required to have effect on the malaria problem. The Royal Commission on Agriculture was also of the opinion that both for the prevention and the treatment of malaria a much wider distribution of quinine is necessary (para 411). According to Bentley, Director of Public Health in Bengal, 100,000 lbs. of quinine must be consumed annually in that province alone before any appreciable effect will be shown.

The estimated figures for the requirements of the country produced from different sources may vary considerably but all alike demonstrate one point, *viz.*, the hopeless insufficiency of the present supplies of quinine.

Extension of Cinchona Plantations:—A great deal of attention was directed to matters pertaining to cinchona in India in the evidence given before the Royal Commission on Agriculture. Eminent witnesses strongly emphasised the need for taking active steps for increasing the area under cinchona cultivation. The question of its centralisation was also brought forward. The evidence showed that for many years there has been comparatively little advance in the extension of cinchona cultivation in India, although large tracts suitable for such plantations are available. The question of centralisation had also been considered some years ago and the decision arrived at was that neither complete centralisation nor provincialisation was possible. The Royal Commission on Agriculture fully comprehended the importance of a sufficient supply of quinine to the public and made far-reaching recommendations in that direction. Influenced by the urgent need for its development, the Commission also recommended that the subject should be made central. Irrespective of the manner in which the provincial governments producing quinine have carried out their obligation in the past, this was considered essential. The imperative need for quinine has been generally felt in all provinces and, as it can only be produced in a few, its production and distribution are properly the function of the Central Government. This was the view which was accepted by the Commission and which it urged for the consideration of the Government. Even with all this force of opinion behind

it, the quinine difficulties of India have not been solved. During the meeting of the Agricultural Conference in Simla in 1928, a committee of representatives of different Provincial Governments concerned in cinchona plantation was convened with a view to advising the Government how far and in what direction the recommendations of the Royal Commission could be carried out. While examining the position the committee was at once brought face to face with the financial aspects of the problem of stocks, and its advice reflects the difficulty of finding a *via media* between the modern tendency to estimate all values in terms of cash and the older philanthropic object with which the Cinchona Department was originally started. The committee recommended a scheme by which all profit which might accrue would be equally shared by all users of quinine, and appealed for co-operation in the larger interests of public health. Nothing of practical value resulted from the discussions which took place, the financial considerations apparently outweighing the interests of public health. Even the visit of the Malaria Commission of the League of Nations, who put quinine and its proper use in the forefront of the methods of attacking this disease, did not help very much to further the interest of quinine production in this country and its distribution to the masses.

Kinabureau :—What has been said regarding the causes of the backward condition of cinchona plantation will show why the country has to be dependent upon foreign sources of supply for which she has to pay very heavily, and why it has to submit to foreign domination regarding the fixation of the price of quinine. It is common knowledge that the world-price of quinine is controlled by a powerful syndicate known as the 'Kinabureau'. Although from time to time many quinine factories have tried to become independent they have always ended up by being subjugated. Even in 1928 many of the quinine dealers attempted to break away from the official prices determined by the 'Kinabureau'. It was for this reason that it became possible at that time to get supplies of quinine in the open market at rates below those officially sanctioned, and by avenues different from that by which they used to reach the retailer. The result was that many old established and reputable firms who carried on big business and who would not sell under the agreed price suffered losses and accumulated large stocks. This might suggest overproduction of quinine in the world,

and yet, one knows that India alone could consume the whole of the world's annual production, if the prices were within the means of the masses, or if the Government undertook a distribution of quinine commensurate with the needs of the population.

The statistics compiled by Andrew Balfour gave the annual figure for the whole world at two million deaths caused by malaria. The death rate being 3 to 4 per thousand cases, it follows that there must be 650,000,000 people suffering from malaria every year, *i.e.*, roughly one-third of the human race. Taking a yearly average of 40 gm. of quinine per patient, the amount of quinine required would be somewhere about 26,000 tons annually. The actual demand, however, depends on the capacity to buy the drug. Millions of sufferers are so poor that their purchasing power is practically nil, or so small that they would not be able to pay the cost even of production of quinine. In practice the production can only take into account the law of supply and demand. The industry cannot produce on the basis of theoretically desired quantity to be consumed at prices below the cost price. The cinchona planters cannot increase their production without an absolutely certain prospect that the extra production will be sold.

The 'Kinabureau' has tried and has been successful in effecting regulated and gradual reduction of the cinchona areas to proportions fitted to what the world can afford to buy and not what it really needs. In this way the price has been maintained at a level that leaves a profit both for the plantations and the factories.

It follows from all this that it would be absolutely futile to expect any large reduction in the price of quinine under the present conditions. So efficient is the control that even the great world wide depression during recent years has not affected the price of quinine, which still remains at Rs. 18 per pound, which was the price fixed so long ago as 1926. This, in spite of the fact that it is being produced in quantity in excess of the world's actual demand though the actual stocks are still well below the world's real requirements. This is the result of production and sale under control.

Although by reason of its climatic condition it will perhaps be difficult for any other country in the world, except South America, to compete with Java so far as cinchona production is concerned, there is no doubt that the Indian plantations could in time be enlarged sufficiently to make India entirely independent of foreign supplies of cinchona alkaloids. India is

the only quinine producing country which can successfully break away from the 'Kinabureau' if it wants to do so.

The reasons for the great diversity between the amount of quinine necessary to cope with malaria and the amount which is actually consumed are not far to seek. There is obviously some powerful factor which is responsible, as otherwise the law of supply and demand would rapidly rectify the shortage. It is also well known that much more quinine is available than is actually consumed. The factor which militates against the more extended use of quinine is its high price. It is unnecessary to stress here that India is a very poor country and that her people with their low standard of living cannot afford to buy quinine for treatment at its present price.

Adulteration of Quinine:—The evil which results from a combination of high price and excess of real demand over supply is that quinine in this country is one of the most frequently adulterated drugs. This fact was strongly brought out by witnesses who recently gave evidence before the Drugs Enquiry Committee. In the Legislative Assembly, Lieut.-Col. Gidney fully thrashed out the subject. Quinine tablets, quinine solutions, quinine mixtures, quinine salts—all come in for a good deal of criticism. Some of the unscrupulous traders are undoubtedly making large profits by this criminal fraud on the public. Adulteration is rife; prescriptions containing quinine in solution, whether made in Government dispensaries or by private chemists and druggists, are said to be frequently dispensed with smaller doses than ordered. Tablets prepared by many firms contain much less quinine than they were stated to contain, and many have none whatever. Major-General J. W. D. Megaw, I.M.S., collected a large number of quinine mixtures from dispensaries of various hospitals in Calcutta, the Punjab and Madras, and found that very few of them contained the requisite amount of quinine. The state of affairs regarding the adulteration of quinine and its preparations is alarmingly serious.

The Factor Responsible for the High Price of Quinine:—The actual cost of production of quinine in the Bengal planta-

tions during the last five years is given in the following table :—

	Cost of bark	Cost of extraction	Total cost
	Rs.	Rs.	Rs.
1925-26	4.18	2.03	6.21
1926-27	3.84	1.59	5.43
1927-28	4.8	2.72	7.52
1928-29	4.6	2.72	7.32
1929-30	4.83	2.72	7.55

It will be perceived that quinine is manufactured at 7.55 rupees per pound at present. The selling price of quinine was fixed at Rs. 24 per lb. in November, 1924, and at Rs. 18 per lb. in May, 1926. Since then the price has remained stationary. It would appear that, even after leaving a fair margin of profit, quinine could be sold at about half the price which is being charged for it and this might bring it within the means of the masses to a considerable extent. It should not be forgotten, however, that the above rates are not worked out on a commercial basis.

All cinchona plantations represent a 'wasting asset' and replanting with or without a period of fallow is essential. Replanted areas rarely yield as much bark as the original plantation, frequently there is a complete failure. Other factors which have tended to increase the price of the bark during recent years are the rise in wages, and growing indirect charges on account of benefits to labour such as recognition of holidays, medical relief and allowances for sick, maternity benefits, allowances for births and deaths, education, sanitation, water supply, etc. When all these factors are taken into account and interest is charged on the capital utilised at the average borrowing rate of the Government, it can be imagined that the cost of production of the bark as well as the manufacturing cost will be considerably increased. When a plantation is not in bearing, the interest charge is added to the capital at compound interest. The cost price of quinine in Madras, where all these factors are taken into consideration, is not far from the rates fixed by the 'Kinabureau' at which it is being sold at present.

The Cinchona Plantation of Bengal may appear to be a paying concern from the report for 1929-30 which shows the valuation profit balance as Rs. 4,53,971-9-3 but this notion will

soon be dispelled if all the factors described above are accorded due consideration.

From this it is obvious that the large volume of criticism regarding the maintenance of the price of quinine at a very high level, in agreement with the 'Kinabureau', is really unfounded, and that there are excellent reasons to continue to adhere to the price fixed by the Bureau. Something should be done to remedy the present state of affairs. Either the price must be reduced by mass production, or research work must be carried out to find out some means of presenting the people of India with quinine, or the total cinchona alkaloids, or the cinchona bark at a cost commensurate with the means at their disposal. In the interest of public health and of supply of pure quinine to the people of India, steps should be taken to lower the price of quinine as much as possible.

Cinchona Alkaloids Other Than Quinine:—The only argument against lowering the price of quinine in India below world prices is that it may lead to export. This could be obviated by imposing a heavy export duty. If it is found impossible to lower the price of quinine, the only alternative is what is suggested by Government Cinchona Department itself (*Vide* Report of Government Cinchona Department and Factory in Bengal for 1929-30, page 4). "We cannot get away from the fact that quinine is the rich man's remedy, while malaria is the poor man's heritage ; but let medicine once admit and practise the value of the other alkaloids and many Indian areas might then be turning out febrifuge at costs more suited to the poor. For, with a change of medical opinion and practice we could make use of kinds of cinchona that do not demand Java soil and climatic conditions for their best development." It is unfortunate for India that of all the alkaloids of cinchona bark the merits of quinine alone should have been recognised by the medical profession, with the result that a monopoly has been created for the plantations and factories of Java. A reference to the history of the treatment of malaria in a recently published work by Lieut.-Col. R. Knowles and Senior-White, shows that this routine use of quinine sulphate is more or less an accident and that "it is very far from certain that quinine is the best

alkaloid of cinchona bark to use. Both quinidine and cinchonidine are more efficacious with regard to their anti-malarial power". The important investigation carried out by Fletcher in Kuala Lampur in the Malay States and the experience at the Calcutta School of Tropical Medicine show that alkaloids of cinchona bark other than quinine are quite effective in the treatment of malaria, if given in the usual doses in which quinine is given. The total alkaloids of the bark in the form of cinchona febrifuge have been used in the Carmichael Hospital for Tropical Diseases and at the out-patient department of the School for many years with very satisfactory results.

It would appear that the efficacy of the other alkaloids of quinine in the treatment of malaria has now been sufficiently recognised by the medical profession, and there is no reason why the policy advocated by the Cinchona Department regarding cinchona plantation should not be adopted. Even if their efficacy against malaria does not quite come up to that of quinine, it will be worth while to have them. Let quinine stand as the remedy for malaria for those who can afford to buy it, but let the total alkaloids of the bark, if not the bark itself, be made available to satisfy the requirements of the masses at a price which they can afford to pay.

Species of Cinchona Suited to India :—Experience in India and specially in the Nilgiris has shown that *Cinchona ledgeriana*, from which most of the quinine supply of the world is obtained, is a relatively weak plant, short-lived, difficult to grow except under optimum conditions, and apparently less vigorous as the quinine content of the bark increases. This tree yields quinine and very small quantities of the other cinchona alkaloids. On the other hand *C. robusta*, which is a more or less fixed hybrid between *C. succirubra* and *C. officinalis*, grows luxuriantly within a wider range of elevation and temperature, is decidedly less subject to disease, and yields quinine and the other alkaloids in more or less equal proportions. Again *C. succirubra*, the most easily grown tree of the lot, yields small quantities of quinine but a high percentage of cinchonidine and cinchonine, and increases in size up to 40 years in South India. It is well-known that the growing of cinchona in India by

private agency has almost completely ceased, due to the fact that *C. ledgeriana*, the bark of which alone found a profitable market, is difficult to grow, and little or no price is paid for those cinchona species yielding barks containing cinchonidine and cinchonine as the main alkaloids.

If a definite authoritative pronouncement was made by the medical authorities calling attention to the value of other alkaloids of the bark, and the free use of cinchonine and cinchonidine is advocated, the problem of making India self-supporting in the matter of treatment of malaria would be made quite easy to solve in the course of a few years. The obvious thing then would be to grow on a large scale the species of cinchona which are specially suitable for the soil and climatic conditions in this country. *C. succirubra* and *C. robusta* are known to do well and further investigation may show other species to be even more suited. If this is not done and the demand for quinine only is maintained, the Cinchona Department with their present policy, will never be able to produce sufficient quantities of this alkaloid to cope with the requirements of the country to efficiently deal with malaria, and what is more important the price of quinine will never be reduced to bring it within the means of the masses. Another advantage of this policy, if adopted, will be that the growing of cinchona by private agencies may be revived, and this may even lead to the extraction of the total alkaloids by private manufacturers. In the following table, the proportions of the important alkaloids occurring in the bark of the roots, stems and branches of the important species of cinchona grown in India (Mungpoo) are given. We are very grateful to Mr. Shaw, Quinologist to the Government of Bengal, for supplying us with this information.

	per cent.	Quinine	Cincho-nidine	Quinidine	Cinchonine	Amorphous	Total
C. ledgeriana—							
Root	in Bark ...	5·11	0·44	0·53	0·68	0·71	7·47
	of Alkaloid ...	68·4	5·9	7·1	9·1	9·5	
Stem	in Bark .	4·14	0·36	0·44	0·25	0·60	5·79
	of Alkaloid ..	71·5	6·2	7·6	4·3	10·4	
Branch	in Bark ...	1·98	0·09	0·14	0·20	0·57	2·98
	of Alkaloid . .	66·4	3·1	4·7	6·7	19·1	
Hybrid—							
Root	in Bark ...	3·10	0·63	0·50	1·22	0·69	6·14
	of Alkaloid ...	50·5	10·3	8·1	19·9	11·2	
Stem	in Bark ...	2·87	0·33	0·34	0·46	0·54	4·54
	of Alkaloid ...	63·2	7·3	7·5	10·1	11·9	
Branch	in Bark ...	1·79	0·21	0·29	0·44	0·66	3·30
	of Alkaloid ...	54·2	6·4	6·2	13·3	20·0	
Officinalis—							
Root	in Bark ..	1·76	0·49	0·52	0·66	0·63	4·16
	of Alkaloid ...	42·3	11·8	14·9	11·9	15·1	
Stem	in Bark ...	2·56	0·89	0·13	0·37	0·47	4·42
	of Alkaloid ...	57·9	20·2	2·9	8·4	10·6	
Branch	in Bark ...	1·44	0·49	0·09	0·19	0·14	2·35
	of Alkaloid ..	61·3	20·8	3·8	8·1	6·0	
Succirubra—							
Root	in Bark ...	1·42	1·12	0·37	3·00	1·30	7·21
	of Alkaloid ...	19·7	15·5	5·1	41·7	18·0	
Stem	in Bark ...	1·74	1·47	0·20	1·63	1·05	6·09
	of Alkaloid ..	28·6	24·1	3·3	26·8	17·2	
Branch	in Bark ...	1·16	0·82	0·20	1·10	0·72	4·00
	of Alkaloid ...	29·0	20·5	5·0	27·5	18·0	

Total Alkaloids of Cinchona Bark.—Cinchona Febrifuge :— The term 'cinchona febrifuge' is rather vague. The total mixed alkaloids of *C. succirubra* were called 'cinchona febrifuge' prior to 1903. After that date it represented a mixture of residual alkaloids remaining after extraction of quinine from the barks of *C. ledgeriana* and its hybrid *C. succirubra*, a certain amount of quinine being added to make it approximately similar to the original cinchona febrifuge in composition (Gage). This is sold to the public in the form of powder and tablets in India, its price being lower than that of pure quinine. As met with generally, it appears to consist of any mixture of the bark

extracts and by-products of quinine manufacture which makers wish to get rid of. Some of these mixtures are of excellent quality and contain a large percentage of the alkaloids, and are considered by many experienced physicians to be therapeutically as good as quinine; others are decidedly inferior and contain small proportions of the alkaloids. The following tables give the composition and the variations in the alkaloidal contents of different specimens which have been analysed.

Quinine	... ...	2.7 to 15.5 per cent.
Cinchonidine	... ...	3.4 to 35.0 ,, ,,
Cinchonine	... ...	18.6 to 33.5 ,, ,,
Quinidine	... ...	4.5 to 22.8 ,, ,,
Amorphous alkaloids	... ...	17.0 to 54.9 ,, ,,

ANALYSIS OF CINCHONA FEBRIFUGE

No.	Source of Samples	Quinine per cent.	Cincho-nidine per cent.	Quinidine per cent.	Cinchonine per cent.	Total Crystalline Alkaloid	Quinoidine (Amorphous Alkaloid) per cent.
1	Cinchona Febrifuge, (Total Alkaloid of *C. succirubra*) ...	15·5	29·0	...	33·5	78·0	17·0
2	Cinchona Febrifuge from Mungpoo (MacGilchrist 1914-15) ...	7·4	5·8	22·8	18·6	54·6	29·1
3	Cinchona Febrifuge, Govt. of India (Gage 1922)	10·5	7·0	16·0	23·0	56·5	33·0
4	Cinchona Febrifuge, Tablet, Govt. of India (Howard 1913)	2·7	3·4	12·5	12·3	30·9	54·9
5	Do	8·0	21·0	4·5	21·0	54·5	30·0
6	Cinchona Febrifuge, (Java)	5·8	12·2	8·7	20·0	46·7	41·3
7	Do ...	11·9	9·2	4·8	15·3	41·2	45·4
8	Cinchona Febrifuge (Quinetum), Europe	8·5	7·0	8·6	28·3	52·4	44·7
9	Cinchona Febrifuge, (Quinetum), used in League of Nations clinical trial ...	15·0	35·0	5·0	25·0	80·0	20·0

The average composition of Indian and Javan cinchona febrifuge and of Indian residual alkaloids is given in the following table (MacGilchrist, 1916 and W. Fletcher 1923).

	Cinchona Febrifuge Indian percentage	Cinchona Febrifuge Javan percentage	Residual Alkaloids Indian
Quinine ...	7.40	11.5	3.0
Cinchonine ...	18.58	26.3	35.0
Quinidine ...	22.83	5.0	20.0
Cinchonidine ...	5.84	20.0	2.0
Total ...	54.65	62.8	60.0
Quinoidine ...	29.12	37.2	30.0
Water and ash ...	16.23	..	10.0

A perusal of the above results will show that the amount of the crystalline alkaloids having an antimalarial action is present in the two brands of 'cinchona febrifuge' as well as the residual alkaloids in sufficient quantities to produce therapeutic effects if given in 10 to 15 grain doses. It will be seen also that 'cinchona febrifuge' has no fixed composition and is frequently adulterated. The 'cinchona febrifuge', as issued from the Government factories in India is mostly the residual alkaloid preparation after most of the quinine has been removed from the bark of *C. ledgeriana*. It can be administered in form of a mixture, tablet, fresh pill or in gelatine capsules. The mixture unless it is properly strained is slimy; the alkaloids, especially the amorphous ones, stick to the mouth and produce nausea. It is, therefore, advisable to give it in tablet form. It is rapidly absorbed and the alkaloids can be detected in the urine in ½ to 2 hours according as to whether it is taken in solution or in pill form. If it is properly standardised it is an excellent substitute for quinine.

Quinetum and Quininum :—Another product of cinchona bark, similar to cinchona febrifuge, used in India is *quinetum*. According to some it is a substance like cinchona febrifuge containing all the alkaloids, but only 15 per cent. of quinine and 5 per cent. of quinidine. According to others it is a mixture of cinchona alkaloids, as they occur in the bark of *C. succirubra* consisting of sulphates of cinchonidine, cinchonine and quinidine with smaller quantities of the sulphates of quinine and amorphous bases. Some even say it is simply a mixture of amorphous bases of cinchona bark, the crystalline alkaloids having been previously removed. Like cinchona febrifuge it is also liable to produce nausea. *Quininum* is an extract prepared according to a French formula. It contains all the constituents of the bark except the woody fibres.

Efficacy of Other Alkaloids :—Experiments carried out by Goodson, Henry and Macfie (1930) in bird malaria have shown that of the cinchona alkaloids the most active was hydroquinine, followed by quinidine, quinine, cinchonidine and cinchonine in

descending order, though there is little to choose among the last four.

Fletcher recently tested the action of different cinchona alkaloids individually in the treatment of malaria ; his conclusions are are follows :—

(1) In doses of 10 grains twice a day the four alkaloids, *i.e.*, quinine, quinidine, cinchonine and cinchonidine, appear to be of equal value in bringing about disappearance of malarial parasites in patients weighing 100 pounds.

(2) None of these alkaloids produce toxic symptoms when given in this quantity, not even cinchonine and quinidine.

(3) In doses of 5 grains twice daily, cinchonine does not appear to be quite so potent as quinine and quinidine.

(4) Cinchonidine sulphate is definitely inferior to other crystallisable alkaloids, when given in small doses.

(5) Quinidine sulphate acts better on the quartan parasites than quinine.

(6) Quinoidine in 5 grain doses does not cause disappearance of the parasites ; in 10 grain doses it cannot be tolerated as it produces severe nausea, vomiting and collapse.

Dale and James (1925) found the curative effects of quinine, quinidine and cinchonine the same on all forms of malaria, and except for the depression caused by the last, no difference in toxicity. Ciuca made similar comparative tests with 'quinetum' and found it to be as effective as pure quinine hydrochloride.

It would appear from this that, so far as the action of the crystalline alkaloids of cinchona bark on malaria and their selective action on benign and malignant tertian parasites are concerned, there is very little to choose between them. Fletcher's conclusions regarding the toxicity of quinidine are not borne out by our experience. It is liable to produce depression of the heart and faintness, and sudden deaths have been known to occur, especially in those suffering from emaciating diseases such as kala-azar. It is evident from the above that much waste has resulted in using only pure quinine,

and the cheaper and equally efficacious alkaloids might well be substituted in the treatment of ordinary cases of malaria, while the more expensive and refined alkaloid may be reserved for severe types of cases.

In strictly controlled tests it has been found that in dosage of 0.1 grain per kilo. of body weight, 'cinchona febrifuge' was less satisfactory than quinine, but when 0.1 grain per pound was given both were equally effective. Any of the preparations such as cinchona febrifuge, 'quininum' and 'quinetum' may be used, provided the amount of the total crystalline alkaloids present is known so that the proper dosage required can be given. For instance if the total crystalline alkaloids present are 70 per cent. or thereabout, it will be known that 10 grains of it are equal to seven grains of quinine. If this is not considered desirable, the sulphate of the total alkaloids of the bark may be used.

Cinchona febrifuge has been very largely used of late years in the treatment of malaria all over India with very gratifying results. The mixture used in the Carmichael Hospital for Tropical Diseases, Calcutta, is as follows :—

Cinchona febrifuge (Indian)	10 grains
Citric acid	20 ,,
Magnesium sulphate	20 ,,
Extract of liquorice	1 drachm
Syrup of Virginian Prune	10 minims
Syrup / Water { equal parts	½ ounce

Dose :—1 ounce three times a day, two and a half hours after food for one week; thereafter twice a day for 24 days. It is liable to produce nausea and vomiting as the amorphous alkaloids present stick to the mouth. The majority of patients, however, tolerate it well if it is taken at tht right time, *i.e.*, 2½ hours after food when the stomach is empty. If nausea and vomiting occur, a dose of 15 minims of 1 in 1000 adrenaline or a minim of tincture of iodine in a little water before the cinchona febrifuge will check the vomiting. If necessary 5 to 10 minims of tincture of opium may be given. Fletcher (1925) came to the conclusion that cinchona febrifuge with 7 to 10 per cent. of quinine was therapeutically as efficient as quinine, in doses of 10 grains twice a day, and it is no more toxic.

References :—

(1) *Report, Drugs Enquiry Committee*, 1931; (2) Goodson, J. A., Henry, T. A., and Macfie, J. W. S., 1930, *Biochem. Jour.*, Vol. XXIV, No. 4, pp. 874-890; (3) *Reports, Cinchona Plantation Factory, Bengal*, 1920-1929; (4) *Sea-borne Trade Statistics, British India*, 1928-1930; (5) *Proceedings, Celebration of the 300th Anniversary of the Use of Cinchona*, 1931, St. Louis, Mo., U.S.A.

CINNAMOMUM CAMPHORA (N.O. Laurineæ) and Other Camphor Bearing Plants

BLUMEA LACERA (N.O. Compositæ)

VERN.—Sans.—*Kukuradru* ; Hind.—*Kakronda* ; Beng.—*Kuksung, Kukursungá* ; Bomb.—*Nimúrdi* ; Tam.—*Nárak-karandai, Kattu-mullangi.*

Camphor is one of the most common remedies and is used in almost every household in India for a variety of purposes. For her requirement of camphor, India is practically completely dependent on foreign countries, China alone sending about Rs. 6,00,000 worth of this drug annually. Besides this, Japan, Formosa and Borneo camphor also find a ready market in India.

An enquiry into the minor forest products of the country will reveal that though *Kaurus camphora*, the camphor yielding tree, does not grow in India, very good substitutes in the shape of the Blumeas grow quite abundantly. Several varieties of these trees, *e.g., B. balsamifera, B. lacera, B. densiflora, B. malcomii, B. grandis*, etc., grow luxuriantly in the Himalayas from Nepal to Sikkim, as well as in the western part of the Deccan plateau at an altitude of 1,700 to 2,500 feet, which are capable of yielding a fairly large amount of camphor. *B. balsamifera* and *B. densiflora* are the two varieties which deserve special mention. *B. densiflora* is a small bushy plant found in various parts of Assam, the Khasia Hills, Chittagong and other places. *B. balsamifera* grows abundantly in Burma, and according to Mason this plant is so abundant that Burma might supply half the world with camphor. Wherever trees

are cut down this weed springs up and often to the exclusion of almost everything else. Dymock drew attention to another camphoraceous Blumea commonly growing near Bombay and used by the people. In addition to the species of Blumea, there are many other plants in India which smell strongly of camphor, some of which would yield camphor. The common aquatic weed of the plains of Bengal, *Limnophila gratioloides,* the *Karpur* of the Bengalees is an example.

In spite of these vast resources India does not manufacture camphor even for her own use and has allowed her market to be flooded with the foreign commodity. The so-called Indian camphor reported in the trade returns is really Chinese camphor refined in India, and in that state is even re-exported. With the exception of a small amount of Blumea camphor there is no camphor which, strictly speaking, could be called truly 'Indian'. A study of the records shows that in the latter part of the 19th century efforts were made to grow the camphor-yielding plants in India. The extensively growing Blumeas as a source of the drug did not attract much notice at that time. From the information now available it appears that attempts were made to grow *Dryobalanops camphora,* a tree closely related to the Indian 'Sal', and the camphor tree of Borneo and Sumatra from which 'Baros' or 'Barus' camphor is derived, and a number of other plants belonging to the N. O. *Dipterocarpeæ* on the Indian soil. In the report of the Lucknow Horticultural Gardens for 1882-83 it is mentioned that camphoraceous trees which were being cultivated there had done well. It seems likely that if sufficient interest is taken in this direction, camphor obtained either from the naturally growing Blumeas or the cultivated *Dryobalanops camphora* tree may be a commercial success.

Economic Aspects:—The camphor tree is a handsome evergreen tree which occurs naturally from Cochin China to Shanghai and from the island of Hainan to Southern Japan. Camphor was formerly produced chiefly in China and also in Japan and Formosa. Production in China has completely declined and the Japanese now are the only producers with Formosa as their chief centre of operations. All parts of the camphor tree yield on distillation a semi-solid oil from which camphor can be separated by mechanical means. The oil from the wood and

root is of the highest value as in addition to camphor, it contains another valuable substance called 'safrole'. The importance of camphor lies in the fact that it is one of the constituents of celluloid and allied products, 70 per cent. of the total output being employed in their manufacture, 15 per cent. is used for disinfecting and deodorising purposes, and 13 per cent. for medicinal purposes. The camphor tree is very largely grown in Formosa and large quantities of camphor are manufactured there. The following table will give an idea of the huge quantities produced.

Japanese Production of Camphor and Camphor Oil
(converted into pounds)

Year				Camphor	Camphor oil
1916	...	...	...	8,689,643	14,680,076 lbs.
1920	...	...	...	4,045,252	9,676,376 ,,
1921	...	...	...	3,380,063	9,632,800 ,,

Almost all the important countries in the world import camphor from Formosa and Japan. In 1919, Japanese camphor was imported to the different countries according to the following table :—

United States of America	... ...	2,092,674 lbs.
Great Britain	... ...	234,156 ,,
France	... ...	194,962 ,,
British India	... ...	90,028 ,,
Australia	... ...	2,701 ,,
Total	...	2,614,521 ,,

Stimulated by the camphor trade of Japan, other countries have turned their attention to the cultivation of the camphor tree, for although in its natural habitat it is restricted within somewhat narrow limits, it grows well when cultivated under widely differing conditions.

In India, as long ago as 1896, Hooper distilled camphor leaves grown at Ootacamund, obtaining from 50 lbs. about 1 per cent. of oil containing 10 to 15 per cent. camphor. The possibilities of camphor cultivation in Northern India have been extensively studied by Howard, Robertson and Simonsen and their researches have been published in the *Indian Forest Records*, 1923. They calculate that with 900 bushes per acre, planted 7 ft. by 7 ft. apart, the yield per acre per annum is 100

lbs. of camphor oil giving 43 lbs. of camphor. For the efficient cultivation of camphor trees at least 50 inches of rain in the growing season is required (*Nature*, vol. 56, 1897) and they suggested that Southern India, where the annual rainfall is 40 inches or more would offer better prospects than Northern India with its extreme variability of temperature and deficient rainfall. It is interesting to note that camphor trees have been experimentally cultivated at Dehra Dun, in Mysore, in the Nilgiris up to an altitude of 7,000 feet, in Burma up to 3,500 feet and in the Shan States notably at Lawksawk where a plantation of 650 acres is situated at an altitude of 3,270 feet. It must be admitted, however, that as far as the British India is concerned, the results of camphor cultivation are not at the moment very promising. This will be appreciated from a comparison of the tables I and II showing the oil content of the Indian tree compared with the original Japanese tree.

TABLE I

Camphor Content of Different Parts of the Camphor Tree Grown in India

Place of Growth	Description of Material	Total Volatile Oil Yield per cent.	Camphor per cent.	Camphor Oil per cent.
Nilgiris ...	Green leaves	1.0	0.1—0.7	0.9—0.3
Madras ...	Do.	2.62	1.99	0.63
Burma ...	Do.	1.51	1.03	0.48
Cochin ...	Do.	2.33	2.01	0.32
Dehra Dun ...	Do.	4.04	0.38	3.66
Dehra Dun ...	Young leaves	4.83	0.59	4.24
Dehra Dun ...	Twigs	0.34	...	...

Note:—Camphor oil is the residue left after camphor sublimes over.

TABLE II

Oil Content of Different Parts of the Japanese Camphor Tree

Twigs	... ...	2.21 per cent.
Branches	... ...	3.70 ,,
Stem	... ...	3.84 ,,
Stump	... ...	5.49 ,,
Root	... ...	4.46 ,,

The exploitation and successful utilisation of the indigenous camphor resources are faced with grave difficulties, and there is every probability that in the near future the manufacture of camphor from the vegetable sources may completely cease. With the rapid growth of the science of chemistry, camphor has been successfully synthesised from the terpenes and this synthetic camphor is gradually taking the place of camphor obtained from natural sources in the commercial world. Synthetic camphor is easily prepared and the finished product may soon be offered for sale at such a price that the growing of camphor-containing plants may not be a paying proposition. To what an alarming extent the synthetic camphor is capturing the field may be estimated from the average amount of production of the material in Germany alone. In 1928 and 1929, the trade returns show an average production of 6,000 to 7,000 metric tons a year of which approximately one-half, 3,049 metric tons were exported to other countries in 1929. The fate of the camphor industry, it would appear, is fast approaching that of the indigo which was formerly a very thriving industry but has been blotted out of existence by production of aniline dyes and synthetic indigo. As things are at present, though synthetic camphor is capturing the markets, Formosa still supplies about 70 per cent. of the world's requirements but the position may soon change completely.

References :—

(1) Hooper, 1896, *Pharmaceutical Journal*, Vol. II, p. 21; (2) Howard, Robertson and Simonsen, 1923, *Ind. Forest Records*, Vol. 9; (3) Finnemore, 1926, *The Essential Oils.*

CINNAMOMUM ZEYLANICUM (N.O. Laurineæ) and Allied Varieties

VERN.—Sans.—*Gudatvak* ; Hind. & Beng.—*Dalchini* ; *Daruchini* ; Tam.—*Lavangap-pattai* ; Punj.—*Dárchini, Kirfa* ; Bomb.—*Taj, Dalchini.*

The term 'cinnamon' is loosely applied to mean the bark derived from several species of trees of the N. O. *Laurineæ*,

e.g., *C. zeylanicum*, *C. tamala*, etc. True cinnamon, or *C. zeylanicum*, does not grow abundantly in India. The tree is known to exist in a wild state in the Western Ghats from the Konkan southwards and has also been met with in the forests of Tenasserim (Burma). Experimental cultivation was also started in South India but the production of cinnamon never assumed commercial proportions. Practically all the supply met with in the drug markets is derived from Ceylon where the tree grows in a state of nature. It is also cultivated there on a commercial scale, and large plantations may be seen in the Galle district in the Southern Province and in the region of Negombo in the Western Province. The tree takes kindly to the light white sandy soil or slightly stiff clay, and is propagated from seeds which are sown in beds and later transplanted. When about 2 to 3 inches high, the tops are cut off to encourage the formation of a stool on which 4 or 5 shoots are allowed to grow. These develop a thick brown corky layer when mature and this after being peeled off forms the cinnamon of commerce. It is sold in the form of long slender sticks containing numerous small quills which are extremely thin and brittle, often marked with longitudinal striations on the inner surface. These are frequently adulterated with a rougher, thicker and less aromatic bark from *Cassia lignea* (*Cinnamomum tamala*), etc.

Cinnamon is used in medicine only to a limited extent. It possesses carminative, astringent and stomachic properties and forms an ingredient of many medicines prescribed for bowel complaints. It is used externally in neuralgia, toothache, etc. Its largest use, however, is as a spice or condiment on account of the presence of the essential oil which imparts a delicious flavour to curries. The chief constituent of the oil is cinnamic aldehyde, though phellandrene, pinene, linalol, caryophyllene, eugenol, etc., also exist in small quantities. The British Pharmacopœia limits the amount of aldehydes to 55 to 65 per cent., but a genuine oil may contain as much as 75 per cent. The leaves also yield on distillation a dark coloured oil, which differs markedly from cinnamon bark oil. This has an odour resembling that of cloves and contains large proportions

(70 to 80 per cent.) of eugenol with traces of cinnamic aldehyde, pinene, linalol, etc.

Ceylon is the chief centre of cinnamon cultivation and carries on an extensive trade in the product as will be seen from a perusal of the table given below showing the area under cultivation and the exports of cinnamon products from Ceylon in 1919-1920.

	Area in acres.	Bark lbs.	Bark oil oz.	Leaf oil oz.
1919	35,083	7,700,560	66,773	229,928
1920	34,662	3,933,552	73,246	365,976

The export trade has since then declined considerably. Thus in 1926, only about 25,000 acres were said to be under cultivation and 483,000 lbs. of bark were sold, out of which the 'chips' not used for distillation amounted to 1,330,000 lbs. This is probably due to the fact that whereas the oil was previously used on an industrial scale as an ingredient of chewing gums and chocolates, substitutes such as cinnamic aldehyde are now being used for reasons of cheapness. Furthermore, the quantity of cinnamon produced per acre is reported to be only 50 to 100 lbs., as compared with 1,000 to 2,000 lbs. of copra and 400 to 600 lbs. of tea. The popularity of cinnamon cultivation has, therefore, suffered considerably and most of the plantations in the Negombo district, where cinnamon was exclusively grown, are now said to be gradually replaced by cocoanuts.

Cultivation in Southern India never assumed large proportions and the produce was usually utilised for internal consumption. A small quantity of leaf oil was produced in North and South Kanara and Malabar and used to be exported. Up to the year 1925-26, the sea-borne trade statistics of British India show an export figure of 222 gallons of cinnamon oil valued at Rs. 10,000 but since then it has completely ceased.

The prospects of cinnamon cultivation in India do not appear very bright at the present moment. Ceylon cinnamon bark is decidedly of a superior quality and the oil has also the reputation of being the best available in the market. If cinnamon cultivation is not remunerative there, it is difficult to see how Indian cultivators will derive economic benefit out of such a scheme. *C. zeylanicum* has also been grown in the Seychelles but the oil obtained differs from that of the Indian cinnamon oil and is reported to be of an inferior quality.

C. tamala or *Cassia cinnamon* is known in Sanskrit as *Tejpatra;* in Hindi and Bengali the leaves are known as Tejpat and the bark as Dalchini. It is widely cultivated in China for its oil, and grows sparingly in the Himalayas at an altitude of 3,000 to 7,000 feet. It also occurs in Eastern Bengal, the Khasia and the Jaintia Hills, and Burma. The cinnamon known as *Cassia cinnamon* or *Cassia lignea* of Indian commerce is obtained from this plant. It is coarser and is sold in larger pieces than the true cinnamon or bark of *C. zeylanicum* for which it is often used as an adulterant. The outer bark of the plant yields on distillation an essential oil which has a pale *yellow colour. Cinnamic aldehyde is the chief constituent of* cassia oil and is contained in the commercial varieties to the extent of 70 to 85 per cent. Although this aldehyde is also the chief constituent of Ceylon cinnamon bark oil, there is an enormous difference between the odour and flavour of the two. In cinnamon oil, the associated materials, *e.g.*, pinene, nonyl aldehyde, etc., have a fragrant and a delicate odour, but in cassia oil, the cinnamic aldehyde is overpowered by the terpenes, etc., which give a somewhat disagreeable odour to the oil. A considerable trade is done in Bombay in Cassia bark and oil, but these are mostly re-exports and not true exports. Definite information regarding the Indian trade in *C. tamala* cannot be obtained but it seems probable that very little if any of the truly Indian bark is exported. The trade in Cassia oil has declined appreciably with the advent of the synthetic cinnamic aldehyde on the market and the adulteration of the oil with cheap terpenes.

C. glanduliferum—the Nepal camphor wood—is a large tree of the South Himalayas from Kumaon eastwards to Assam, the Khasia Hills and Sylhet. The bark of the tree is rough, pale brown, highly scented, with a strong smell of camphor when freshly cut. In the Indian Pharmacopœia this plant has been recommended as worthy of more attention than has been hitherto paid to it. The wood and the leaves yield a crystalline product which has been shown by Schimmel & Co. to be d-camphor. It has been suggested as a substitute for oil of sassafras, which is obtained from the root of *S. officinale,* a tree growing in

Virginia and Tennessee. Sassafras oil is costly and is used to a large extent in the manufacture of soap and perfumery. But it is doubtful whether *C. glanduliferum* can really act as a good substitute for the above oil.

References :—

(1) Parry, 1921, *The Chemistry of Essential Oils and Artificial Perfumes;* (2) Finnemore, 1926, *The Essential Oils;* (3) Schimmel & Co., 1928, *The Report.*

CITRULLUS COLOCYNTHIS (N.O. Cucurbitaceæ)

Colocynth ; Bitter apple.

VERN.—Sans.—*Indra varuni ;* Hind.—*Indrayan, Makal ;* Beng.—*Makhal, Indrayan ;* Bomb.—*Indrayan ;* Tam.—*Peyt-lumatti, Paycumuti ;* Punj.—*Ghurumba, Tumbi.*

Colocynth is widely distributed throughout India. It grows in a state of nature in the arid tracts of North-West, Central and South India, and is met with in the Punjab, Sind and on the Coromandal coast. The fruit ripens in the cold season and is offered for sale in North India by the herbalists in December and January. The roots and the whole fruit without the seeds are commonly used in India whereas only the pulp is official in the British Pharmacopœia. The Indian varieties of colocynth differ a little from the imported varieties and are nearly globular in shape and usually of the size of an orange or smaller with a surface marbled with green and yellowish white patches. A number of substitutes of *C. colocynthis* are found on the market. The fruit of *Cucumis trigonus, Cucumis pseudo-colocynthis,* and *Cucumis hardwickii* grow abundantly in the mountainous regions of Northern India and are frequently used to adulterate colocynth sold in the bazar. They can be differentiated from the round fruits of the true drug by their smooth contour and oblong shape. Colocynth is not systematically grown anywhere in India.

When fresh, the pulp is spongy and juicy but when dry the fruit becomes yellowish white and contains a scanty yellowish pulp embedded inside the fruit. The pulp separates from the rind with difficulty and consequently peeled colocynth of Indian origin is seldom found in the

market. Whatever peeled colocynth is met with, is imported from the Mediterranean coast. The proportions of the pulp, seeds and rind are 15 : 62 : 23 respectively in 100 gm. of the dried fruit. On an average the fruit yields 12 to 15 per cent. of the dry pulp. All parts of the plant are very bitter, and contain traces of an alkaloid and the bitter principle 'colocynthin'.

Colocynth is a very old remedy in the Hindu medicine. The fruit has been described as cathartic and useful in biliousness, constipation, fever and intestinal parasites. The root is used in ascites, jaundice, urinary diseases and rheumatism. The Mohammedan physicians use this drug extensively in their practice as a drastic purgative in ascites and jaundice and in various uterine conditions, especially in amenorrhœa. There is also mention of the drug in Greek and Roman medicine.

Chemical Composition :—There is practically no difference in the chemical composition between the Indian and European varieties ; both owe their physiological activity to the alkaloid and the bitterprinciple 'colocynthin'. The alkaloid is only present in very minute quantity and could not be isolated in a pure state. The following table gives the analytical results of specimens of Indian colocynth which were analysed by the Department of Chemistry at the Calcutta School of Tropical Medicine :—

		Pulp	Whole fruit (dry)
Petroleum ether extract	...	0.61	1.36
Sulphuric ether extract	...	3.17	2.04
Alcoholic extract	...	10.90	12.15

The bitter principle is nearly completely extracted by sulphuric ether after first removing the oily matter by petroleum ether. Traces of the alkaloid can be found both in the ether and alcoholic extracts. Ethyl acetate is also a solvent for the bitter principle and an extraction with this solvent after a preliminary treatment with petroleum ether gives a residue of about 3.45 per cent. of the weight of the dry pulp. The major portion of the bitter principles is soluble in water, is intensely bitter and gives a white precipitate with tannic acid, from which it can be obtained in a purer condition. The average yield of the bitter principle is thus not less than 2 per cent. on the weight of dry pulp which compares favourably with the standard in the British Pharmacopœia.

Colocynth is used in medicine as a drastic purgative, and in the form of solid extract enters into many of the purgative pills of modern pharmacy. Although a fair amount of Indian colocynth is used in the country, large quantities of the fruit as well as preparations made from it are annually imported from Europe, Arabia and Syria. In Spain and Cyprus, colocynth apples are actually cultivated for purposes of export. In fact imported colocynth fruits and solid extracts are more in evidence on the market than the preparations made from the drug of Indian origin.

References :—

(1) Power and Moore, 1910, *J. C. S. Trans.*, p. 99; (2) Chopra and others, 1929, *Ind. Jour. Med. Res.*, Vol. XVI, Jan.

CITRUS MEDICA, var. ACIDA (N.O. Rutaceæ)

The Lime tree

VERN.—Hind.—*Nimbu* ; Beng.—*Nebu.*

CITRUS MEDICA, var. LIMONIS (N.O. Rutaceæ)

The Lemon tree

VERN.—Hind. and Beng.—*Paharinimbu, Jambir, Gora nebu.*

The recognition of the antiscorbutic properties of lime juice has made the fruit famous in therapeutics and in almost all countries it is considered to be a necessary adjunct to the ordinary diet. In medicine and perfumery also, lemon plays an important part. A pale yellow, bitter aromatic volatile oil is derived on expression from the fresh outer part of the pericarp of the fruit and is highly prized in medicine as a flavouring agent, carminative and stomachic. Two kinds of limes are found in the Indian market—'Pati' and 'Kagzi'. The lemon is popularly known as 'Paharinembu' or 'Jambir' and though belonging to the same stock, differs from the lime fruit in being bigger in size with a rough, thin and loose rind. The lemon

tree is common in the Central Provinces as well as in Kumaon, whereas lime grows wild in forests of Assam, Chittagong (Sitakund Hills), the Khasia and Garo Hills. Both these varieties, notably the lime, are also extensively cultivated in many parts of India, particularly Northern India. Considering the attention paid to the cultivation of these fruits in other parts of the world, very little seems to have been done to this industry in India. The lemon industry has flourished in Sicily and to a lesser extent in Calabria (Italy), but the tree also grows luxuriously in many parts of the world notably in Spain, Portugal, France, California, Florida, the West Indies and New South Wales. A large quantity of lime juice, lemon oil and other bye-products, *e.g* , citric acid, citrus pictin, etc., are imported into India. On an average 1,000 to 1,500 gallons of lemon oil are annually shipped to this country valued at Rs. 50,000 to Rs. 60,000. Although no records are available regarding the amount of lemon juice cordial and other beverages containing these ingredients which are being received in all parts of India, there is no doubt that these form quite a large portion of the imports. The quality of Indian lemon peel is almost equal to the Sicilian variety and it has been estimated that if extraction of lemon oil is attempted from the Indian lemon peel, it will not be a failure commercially. The percentage of essential oil is less in lime than in lemon but the latter is richer in juice and citric acid ; the average amount of critic acid available from 100 c.c. of lime juice is about 5.9 per cent. whereas that obtained from the same quantity of lemon juice is 3.7 per cent. It will appear that the lemon-growing industry, if taken up on a sufficiently large scale, is very likely to pay its own way. Lemon growing is not difficult. It requires a moist and sheltered climate with dry invigorating air and abundant sunshine—conditions which can be easily attained without much outlay of capital in many parts of India. The problem of proper and efficient irrigation of the soil can also be successfully met by proper selection of the locality. The well-drained regions at the foot of the Ghat Hills have been suggested by certain agricultural experts and their possibilities in this direction deserve a thorough investigation. Indeed, the cultural

conditions existing in India cannot in any way be said to be very much inferior to those prevailing in California, Florida and New South Wales where the citrus industry has recently established itself and made rapid advance. A perusal of the report of the California Fruit Growers Exchange, which controls the citrus industry there, shows what can be accomplished by co-operative efforts and by the application of modern scientific agricultural improvements. For nearly four months in the year the frosty climatic conditions prevailing in California are distinctly injurious to the lime crop. By heating up the orchards with artificial heat at the time of the frosts, the agriculturists obviate the risk of damage to their crops. If in these countries, in spite of the inclement weather, the lime and lemon industry can make such headway, it is difficult to understand why India should fail in raising citrus plantations on a large scale and in utilising the raw materials and bye-products obtained therefrom.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Dutt, 1928, *Commercial Drugs of India;* (3) *Year Book of Agriculture*, 1930, U.S.A. Publication.

COLCHICUM LUTEUM (N.O. Liliaceæ)

VERN.—*Surinjan*.

The corms and seeds of *Colchicum autumnale* are official in the British Pharmacopœia and are used extensively in Western medicine as a sovereign remedy for gout. This plant grows in the meadows throughout Europe but is not found in India. Attempts have frequently been made to introduce this species into India but with very little success. Though the *Colchicum autumnale* does not grow in India, a very good substitute in the form of *Colchicum luteum*, Baker, is available. It grows extensively in the western temperate Himalayas and is met with in open pasture lands or in the outskirts of forests extending from the Murree Hills to Kashmir and Chamba. It is a medicine of great repute in Afghanisthan and Northern

India. A dark brown dry extract sold in small pieces prepared from the corm can be obtained from the drug-sellers in the bazar.

There are two species commonly sold in the Indian bazars; one is sweet and the other bitter. The bitter variety is *C. luteum* which contains the alkaloid *colchicine* in fairly large proportions; the sweet variety also contains traces of an alkaloid which has been found to be physiologically inactive. *C. luteum* or *Surinjan-i-talkh* is distinguished from the sweet variety *Surinjan-i-shirin* by its bitter taste, smaller size, darker colour and a reticulated appearance of the corms.

The medicinal properties of this plant were well-known to the Arabs. The Kashmir Hermodactyls or *Surinjan-i-talkh* was and is still used by the Mohammedan physicians as an alterative and aperient, especially in gout, rheumatism and diseases of the liver and spleen. In gout, it is combined with aloes; with ginger and pepper it is used as an aphrodisiac; a paste is made with saffron and eggs and is applied to rheumatic and other swellings; powdered root is sprinkled on wounds to promote cicatrisation. *Hiranya-tuttha* or *Haran-tutiya*, a medicine of great repute in Afghanistan and Northern India, is a dark-brown dry extract prepared mainly from the aqueous extract of *Colchicum luteum* and other species. In Hindu medicine 'Tutham' or 'Tuttanjana' is the term applied to a collyrium made of copper sulphate and root of *C. luteum*.

The corms of *C. luteum* are occasionally adulterated with corms of the sweet variety and another plant, *viz.*, *Narcissus tazetta* belonging to the same natural order. This plant grows abundantly in Persia and is supposed to have similar properties. A variety known as *C. speciosum*, Stev., commonly grows in Badghis and Khorasan and finds its way into India. The seeds of colchicum are not commonly sold in the Indian bazars.

According to Dymock, Warden and Hooper (1893), the ether extract, *i.e.*, the alkaloid-containing part, was 1.31 per cent. in bitter 'surinjan' obtained from Lahore and 0.69 per cent. in sweet 'surinjan' (Merendera persica) from Persia. The corms of *C. luteum* have been examined at the Calcutta School of Tropical Medicine and they appear to resemble *C. autumnale* in their general form. Chemical analysis shows that they contain a large amount of starch, a small quantity of oily resinous matter and a bitter alkaloid. Following the assay methods laid down in the United States Pharmacopœia, the percentage of the alkaloid in the air-dried corms of *C. luteum* was found to be from 0.21 to 0.25 and in the seeds from 0.41 to 0.43 per cent. The alkaloid thus obtained has the same properties as that of the official alkaloid

colchicine obtainable from the official *C. autumnale*. The U. S. P. requires 0.35 per cent. of alkaloid in the corms and 0.45 per cent. in the seeds. No standard, however, has been fixed by the British Pharmacopœia; it is merely recommended that the seeds should be employed for the preparation of the tincture and the corm for the extract or wine of colchicum. The alkaloid colchicine is liable to be affected by high temperature. The corms should, therefore, be collected early in the summer and dried at a temperature not exceeding 65°C. Attention to this direction may increase the percentage of the alkaloid.

It would appear from the above analysis that both the corms and the seeds of *C. luteum* or 'surinjan-i-talkh' sold in the Indian market could be used for therapeutic purposes in place of *C. autumnale*. It may, therefore, be confidently expected that *C. luteum* will in future be more extensively employed in the preparation of galenicals in India than has hitherto been the practice.

References :—

(1) Dutt, 1928, *Commercial Drugs of India*; (2) Chopra and others, 1929, *Ind. Jour. Med. Res.*, Jan., XVI, 3, 770.

DATURA STRAMONIUM (N.O. Solanaceæ)

VERN.—Hind.—*Dhatura*; Beng.—*Sada Dhútúrá*; Tam.—*Umatai*; Punj.—*Tattur, Dattura.*

Dhatura was known to the ancient Hindu physicians. They regarded the drug as intoxicant, emetic, digestive and healing. Smoking of datura seeds as a treatment for asthma was known during the Vedic period. Its toxic properties were well-known and there is frequent mention in the literature of its use for suicidal and homicidal purposes. Dried leaves and seeds of *D. stramonium* are used in the British and the United States Pharmacopœias as antispasmodic in such conditions as asthma, whooping cough, etc. As seen in commerce, the leaves are brownish or yellowish green, about 20 cm. long and 13 cm. broad. They closely resemble stramonium leaves in appearance and have a similar characteristic odour and a bitter taste. The

active principles contained in the seeds are the alkaloids *hyoscyamine*, *atropine*, and *hyoscine*. *D. stramonium* is indigenous to India and grows abundantly throughout the temperate Himalayas from Kashmir to Sikkim.

There are two varieties of *Datura fastuosa*. The black variety is known as 'Kala-dhatura' in Hindi and the white varicty is known as 'Safed-dhatura'. *D. fastuosa*, var. *alba* (Safed-dhatura) is widely distributed in the temperate Himalayas from Kashmir to Sikkim. It is particularly abundant along the east and west of the outer Himalayas and covers a region of over 1,000 miles. It grows abundantly in Kashmir and around Simla and is to be found along the roadside and in villages, but is rarely seen on the wild uncultivated hills. In the deep valley of the Sutlej, it is particularly plentiful, miles of the country being literally covered with this plant. Both these varieties have been known to the people of India for their intoxicating and narcotic properties. The black variety is considered to be more powerful. The seeds are used for adulterating many intoxicants such as toddy, rice-beer, etc., and they are also mixed with *ganja*.

Chemistry of D. stramonium and D. fastuosa :—There are marked variations in the alkaloidal content of *D. stramonium* grown in different localities. These vary from 0.47 to 0.65 per cent. The mixed Indian seeds from *D. fastuosa* give a total alkaloidal content of 0.23 per cent., consisting chiefly of *hyoscyamine* and *hyoscine* in proportion of 2 to 1, together with a little *atropine*. The capsules contain 0.1 per cent. of total alkaloids consisting chiefly of hyoscine only. The seeds of *D. fastuosa* (*D. alba* variety) contain 0.216 per cent. of hyoscine, 0.034 per cent. of hyoscyamine, and traces of atropine. The leaves and seeds of the variety *alba* were made official in the Pharmacopœia of India and galenical and other preparations like tinctures and plasters were frequently used. Both varieties, which possess narcotic and anodyne properties, are useful in neuralgia and act as antispasmodics. Datura possesses properties analogous to those of belladonna. The leaves made into cigarettes are smoked to relieve asthmatic attacks.

Economic Aspects :—There is a large demand for the preparations of *D. stramonium*. Besides the galenical preparations made from it, it is the main ingredient of cigarettes and the

fumigating powders employed in asthma. The plant has been cultivated in America to get supplies for medicinal purposes. In view of the plentiful supplies met with in India it is surprising that most of the stramonium preparations and the alkaloids hyoscyamine and hyoscine should be imported from outside. The alkaloidal content of *D. fastuosa* is undoubtedly low, but it grows so abundantly that it would be worth while using it in medicine, not only in the form of ordinary galenical preparations but also for extraction of the alkaloids hyoscyamine and hyoscine.

DIGITALIS PURPUREA (N.O. Scrophulariaceæ)

Foxglove

Digitalis purpurea, commonly known as foxglove, is a biennial herb belonging to the natural order *Scrophulariaceæ*, or the figwort family. It was originally a native of Western Europe but is now extensively grown in many parts of the world. There are a number of species of this plant having the same physiological action, though differing in their degree of potency. For instance, *Digitalis purpurea* is more effective than *D. campanulata* or *D. alba*, but *D. ambigua* from Austria shows a therapeutic activity equal to *D. purpurea*. For many years, English-grown leaf was supposed to be the best in the market, but recently, Germany and Austria have supplied large quantities of good leaf to the world. During the War the supply from the German sources was cut off and the Americans tried to develop their resources. In California, Oregon and Washington digitalis grows wild and the leaves collected from these plants were found to be active and of sufficient potency to allow their use for medicinal purposes. One of the American-grown species is *D. lutea* which, therapeutically, is as good as *D. purpurea*; in fact, it has the reputation of having much less toxic effects on the gastro-intestinal tract.

In India a large amount of digitalis is used every year. This can be judged from the fact that Messrs. Smith Stanistreet & Co., a firm of manufacturing chemists of Calcutta, writing

in 1912 said that they alone could use 3 to 4 cwts. of the Indian-grown leaf if it was as active as the imported leaf. The consumption has gone up considerably since then. A major portion of the digitalis used by the medical profession in this country is even now imported, and the problem has not only its economic aspect, but from the medicinal point of view the fact should be borne in mind that the digitalis preparations imported into India are liable to lose 20 to 40 per cent. of their potency in a very short time. The author and his co-workers some years ago investigated the properties of digitalis grown in India in order to see if the Indian leaf and its preparations could be advantageously substituted for the imported commodity. The result of this work has been that the Bengal Chemical & Pharmaceutical Works of Calcutta now use nearly a ton of leaf every year, all grown in India (Kashmir).

Before entering into a discussion of the therapeutic efficacy of the digitalis leaf grown in different places in India it will not, we think, be out of place to give a brief account of the cultivation, methods of collecting, drying and storage of digitalis leaf adopted in this country.

Cultivation of Digitalis purpurea in India :—So far as is known none of the species of digitalis is indigenous to India but *D. purpurea* has long been grown in gardens in different hill stations as an ornamental border plant. As early as 1880 attempts were made to grow the plant in the Government gardens at Saharanpur and hill gardens in Mussoorie for a regular crop of leaves for medicinal purposes. The plant, however, did not flourish as it was reported to yield very few leaves and the cost of producing was higher than that of the imported leaf. Systematic cultivation was, therefore, for the time being abandoned in these places. In the Kumaon gardens the plant did better and in 1912 leaves were examined chemically by Martindale and found to be well above the standard so far as the active principles were concerned. The plant was cultivated in other places and the cinchona plantation authorities at Mungpoo near Darjeeling (Himalayas) and also in Burma took it up. It was also introduced into the Nilgiri Hills and largely grows there from self-sown seeds, and the cinchona plantations supply it to the Government Medical Store Depots at 3 annas per pound. As grown at Mungpoo it calls for very little attention in the matter of cultivation and grows well in open spaces at a height of 6,000 feet above the sea level. Thousands of seedlings appear and nurseries for rearing are not necessary.

Before planting a new block the ground is first cleared of jungle and dug to a depth of one foot. Then, with the aid of a rope, pegs are put in rows 2 ft. apart and 10,800 plants are planted per acre. The plants are grown for about 12 months, during which time it may be necessary to sickle the block twice and to hoe it once during the cold season. When grown in this way the plant does well and yields a good crop of leaves.

Collection of the Leaf—Digitalis usually begins to flower in India about the end of April and early in May, when the plants are in full bloom and two-thirds of the flowers on each spike are fully developed, leaf picking commences and goes on throughout the hot weather. In Europe and America the leaves are also collected throughout the summer from July to September when the plant is flowering. The best product is, however, gathered in the early part of the summer, about the month of June, just before the flowers have expanded. It was recommended that leaves should be collected from plants of the second year growth, but investigations have shown that first year leaves have the same glucoside content as those of the second year, and in India leaves are generally gathered from plants, irrespective of their age. The leaves are plucked by hand, being twisted or broken off without taking the thick fleshy leaf-stem. The lower basal leaves of poor colour are rejected, also the upper smaller leaves of the stem. Practically three-fourths of the total number of leaves per plant are taken, both young and old being mixed during collection. No particular attention is paid to weather conditions during the collecting period. It is at the beginning of the monsoon and the weather is usually dull and showery about that time.

Withering and Drying—Each day's collection of leaves in this country is spread in thin layers on bamboo 'machans' and left to wither for 36 hours, being turned over occasionally to prevent fermentation. Finally, drying is completed in a 'sirocco' or oven at a temperature of 150°F. Without the use of the oven it would be very difficult to dry the leaves thoroughly during the monsoon. Drying in an oven, however, has been shown to cause a marked deterioration, especially if the temperature is allowed to run high. Our experience with Indian leaf is that sun- or air-dried leaves, such as those from Kashmir, retain their activity very much better than the oven-dried leaves.

Storing.—After drying, the leaves are stored in dark sheds. They are kept on the floor in a heap and covered with bamboo mats to exclude dust and light. Hatcher's recent work in America appears to show that no special precautions regarding storage, such as keeping the dried leaves in air-tight tins with a perforated bottom containing freshly burnt lime, are necessary in that country. In warm and moist climates, such as that of India, our experience is that unless such precautions are taken the leaf deteriorates in its therapeutic

activity. Digitalis leaves kept in air-tight bottles in our laboratory kept their activity better than those left exposed to the moist air, especially during the hot weather.

Physiological and Therapeutic Activity of Indian Leaf:—In 1913, Dr. Gordon Sharp carried out a biological assay of digitalis grown in India. He found that the Indian-grown leaf on casual examination looked in every way like the ordinary wild or partially cultivated variety grown in England and Germany. Their taste was equally bitter. On closer examination the Indian leaves had a coarser stalk and the venation was somewhat coarser. The leaves themselves were darker and tougher than the European leaves but not very different from wholly cultivated leaves grown in the south of England. The tinctures prepared from these leaves were darker and contained more resinous matter than those prepared from the British or German varieties. Mungpoo leaf gave good results by biological assay by the 'frog method' and by therapeutic trial on the human heart. Dr. Sharp pronounced that *D. purpurea*, Linn., leaf grown in Mungpoo was at least equal in potency to British or German grown leaves. The leaf grown in the Nilgiris, however, failed to produce equally good effects.

In 1920, Dr. Douglas Cow of the Pharmacological Laboratory at Cambridge, assayed tinctures prepared by Messrs. Smith, Stanistreet & Co., from the leaves grown in Mungpoo and in the Nilgiris. One c.c. of tincture made from Mungpoo (Darjeeling) leaf was found to contain 8 H.T.U. (compared with equivalent standard of 1 c.c.=6.5 H.T.U.). Its M.L.D. per gram of frog was 0.125 c.c. Perfusion of the isolated rabbit's heart produced 100 per cent. increase in amplitude and 25 per cent. slowing. Dr. Cow pronounced the sample to be of adequate strength, showing reasonable therapeutic properties. In the case of the Nilgiri leaf he found that although by the 'frog method' the tincture was found to be nearly double the strength of ordinary tincture—12.5 H.T.U. in a c.c. instead of 6.5—yet when tested by perfusing an isolated mammalian heart—it produced no increase in amplitude of the heart beat and no slowing as is usual with active tincture. Dr. Cow expressed the opinion that this negative effect on the mammalian heart need not condemn the sample and that it may possess adequate therapeutic properties which in this instance are over-shadowed by the muscle poison effect.

In the end of 1922 the Government of India Medical Stores Department first sent the author tinctures made both from Mungpoo and Nilgiris leaves and since then a number of other tinctures made from the leaf grown in India have been assayed, the assay being carried out by a modification of Hatcher's 'cat method'. Chemical assay was also done at the same time by Kundson and Dresbach's chemical method. The following table shows the results that were obtained :—

TABLE

Showing Assay Results

No	Date of Assay	Physical characters of dilute solution	Percentage of slowing of intact mammalian heart	H. F. U. per c.c. of tincture	Amount in c.c. equalling 1 c.c. of standard tincture	Remarks
		A. Tinctures prepared from leaf grown in Mungpoo (near Darjeeling, Himalayas)				
1	Early 1923	Dark with black particles		7.9	0.82	Specimens varied in activity
2	17-9-24	Opalescent green	15.0	5.2	1.25	
3	18-9-24	Do	12.5	3.55	1.83	
4	15-7-25	Yellowish green	19.0	3.8	1.7	Tried clinically. Patient could be got under digitalis effect with 8 to 10 drachms of tincture per 100 lbs. body weight
5	17-7-25	Do	26.8	3.23	2.01	
6	3-9-25	Opalescent greenish yellow	4.76	6.25	1.04	
7	Dec 1925	Light blackish yellow	9·1	6.69	0.972	
8	Do	Light greenish yellow	7.7	3.7	1.742	
		B. Tinctures prepared from leaf (sun-dried) grown in Kashmir (Himalayas)				
9	9-9-24	Opalescent darkish green	56.66	9.3	0.7	Tried clinically. Patient could be got under digitalis effect with 4 to 7 drachms of the tincture per 100 lbs. body weight
10	11-9-24	Do.	60.5	9.7	0.68	
11	1-9-25	Opalescent greenish yellow	38.0	6.43	1.01	
12	18-9-25	Do. ..	44.0	8.44	0.77	
		C. Tinctures prepared from leaf grown on the Nilgiri Hills				
13	Early 1923	Dark blackish with ppt	Nil	5.8	1.12	Very toxic when assayed by the 'cat method'
14	Do	Do	Nil	5.2	1.21	
15	5-8-25	Do	Nil	18.0	0.36	
16	6-8-25	Do ...	Nil	13·2	0.49	
17	7-8-25	Do	Nil	17.1	0.38	

A perusal of the table will show that of the 17 specimens of digitalis leaf assayed, eight were from Mungpoo near Darjeeling, Eastern Himalayas, four from Kashmir, Western Himalayas and five from the Nilgiri Hills in Southern India. It will be seen that the specimens from Mungpoo varied a great deal in their activity when tested by the 'cat method'. Some specimens (Nos. 1, 2, 6 and 7) were quite active, while the others (Nos. 3, 4, 5 and 8) were comparatively weaker. Slowing of the mammalian heart with these tinctures was also variable and was not so marked as in the case of Kashmir-leaf preparations. These variations were probably due to the method of drying and storing adopted, which we have already described. It is difficult to maintain a perfectly uniform temperature in the ovens that are used, and if the temperature rises above 150°F deterioration of the glucosides occurs, accounting for the loss of potency of the specimens. Storage of leaf also appears to have some bearing. Under the present conditions the leaf after drying is simply heaped up on the floor in darkened rooms and although the atmospheric temperature does not rise so high in the hills as it does in the plains, it becomes quite warm at times and as the air is full of humidity, fermentation is favoured and the glucosides are split up. These factors are sufficient to account for the variations in the therapeutic efficiency of different specimens of leaf. Clinical trials with tinctures made from Mungpoo leaf showed that patients could be digitalised with reasonable quantities of this preparation (8 to 10 drachms per 100 pounds body weight). It can be concluded, therefore, that a good quality of digitalis leaf can be grown in Mungpoo, and with improvements in methods of drying and storing, adequate and reliable supplies could be obtained for therapeutic uses from this source.

The specimens of leaf from Kashmir gave excellent results both by biological assay and clinical trials. In Kashmir digitalis is now grown on a large scale. The leaves are sun-dried and are packed in air-tight tins. Kashmir is not affected so much by the monsoon as the Eastern Himalayas where Mungpoo is situated, and drying in the sun without the use of ovens is possible. The growing of digitalis in Kashmir has great possibilities. Freshly made tinctures from this leaf digitalised patients with 4 to 7 drachms per 100 lbs. body weight.

Variations in the Potency of Digitalis Preparations in the Tropics:—A perusal of what has been said above, shows that digitalis leaf of good quality can be grown in some parts of India. This is of special importance in view of the observations by the author and his co-workers (1925-26) regarding the keeping properties of digitalis leaf and the preparations made from it in tropical climates. Biological assays were carried out by

Hatcher's 'cat method' and the 'frog method' and chemical assays by 'Kundson and Dresbach's method'. As none of these methods gave a very accurate idea of the therapeutic activity of a preparation, clinical tests were also carried out with the same tinctures. The average dose of 15 c.c. (or 4½ drachms) of the tincture per 100 pounds of body weight required to get the patient under digitalis effect in 36 to 48 hours is considerably increased if the tincture was deteriorated. By both these methods it was shown that the tinctures manufactured by reputed English and American firms showed in a very short time a reduction of 20 to 40 per cent. in their strength. Even fresh tinctures sent out soon after their manufacture and assayed soon after arrival seemed to deteriorate during transit. The deterioration is due to some change taking place in the digitalis glucosides, the nature of which is unknown. Such tinctures on dilution (1 in 10) become darkish in colour, unlike good tinctures which are light green and uniformly opalescent. These tinctures although they become more toxic when given to a cat intravenously and, therefore, having a small minimum lethal dose, are considerably weakened so far as their therapeutic activity is concerned.

It has also been shown that fresh tinctures prepared from *Digitalis purpurea* leaf grown in Kashmir or in Mungpoo showed their normal potency. Digitalis leaf also is liable to rapid deterioration if it is not properly cured and if it is badly stored. The outcome of this work is that the Indian grown digitalis is rapidly replacing the imported digitalis. A number of manufacturing firms in India supply freshly prepared tincture from fresh leaf to their customers. Distinct advantage can be gained by using freshly made tinctures from freshly collected and properly dried digitalis leaf grown in India. Cultivation of digitalis in India on proper line has a great future.

References :—

(1) Chopra, Bose & De, 1925, *Ind. Med. Gaz.*, Vol. LX, March; (2) Chopra & Ghose, 1926, *Ind. Jour. Med. Res.*, Vol. XIII, p. 533; (3) Chopra & De, 1926, *Ind. Jour. Med. Res.*, Vol. XIII, p. 781; (4) Chopra & De, 1926, *Ind. Med. Gaz.*, Vol. LXI, March; (5) Chopra &

De, 1926, *Ind Med. Gaz.*, Vol. LXI, May; (6) Chopra & De, 1929, *Ind Med. Gaz.*, Vol. LXIV, June.

ELETTARIA CARDAMOMUM (N.O. Scitamineæ)
Tribe Zingiberaceæ

The Lesser Cardamom; Cardamom.

VERN.—Sans.—*Ela*; Hind. & Beng.—*Chhoti elachi*; Bomb.—*Elachi*; Tam.—*Ella-kay*; Pers.—*Kakilahe-khurd.*

The cardamom is a perennial plant with thick, fleshy rhizomes and leafy stems, 4 to 8 feet in height with a long branched inflorescence which arises near the ground. It is indigenous to Western and Southern India, in the rich moist forests of Kanara, Mysore, Coorg, Wynaad, Travancore and Cochin; it is also cultivated there on the tea and rubber estates by both European and Indian growers. On the coffee estates of Coorg and Mysore it is grown in gullies and ravines, as it thrives best in such damp, shady places. It is also found wild in Burma. Several varieties of the true cardamom are met with in the market.

(1) The Mysore variety forms the bulk of the commercial article. It is ovoid and has a pale creamy, nearly smooth surface; it is more robust and bears exposure better than the Malabar variety.

(2) The Malabar variety which is smaller, shorter and plumper and not so smooth. This variety was formerly imported into Great Britain but is now replaced by the Mysore variety.

(3) The Mangalore variety which resembles that from Malabar, is almost globular but is larger and has a rough skin.

(4) The wild or native variety from Ceylon, *E. cardamomum*, var. *major*, Smith, is elongated, shrivelled in appearance, and of a rather dark greyish colour.

Cardamom is an article of some commercial value. It is exported largely to foreign countries where it is used as a spice and as a flavouring agent. An oil is extracted from the fruits and is used both in pharmacy and perfumery. It occurs to the extent of 4 to 8 per cent. of the seeds and contains a considerable amount of terpinyl acetate; cineole,

free terpineol and probably also limonene are present. The following figures may be taken as covering most pure samples:—specific gravity 0.923 to 0.945; optical rotation $+24^{\circ}$ to $+48^{\circ}$; refractive index 1.4620 to 1.4675; acid value 1 to 4; ester value 90 to 150.

The majority of cardamoms of commerce imported from Ceylon are described as 'Ceylon-Malabars' or 'Ceylon-Mysores'. An estimate of the amount of export trade may be obtained from the Ceylon figures for 1915, 1922 and 1923:—

1915	519,039 lbs.
1922	458,742 ,,
1923	292,682 ,,

Amomum subulatum (N.O. Scitamineæ)

The Greater Cardamom

VERN.—Sans.—*Ela*; Hind & Beng.—*Bara-elachi*; Tam.—*Periya-yelakay*; Pers.—*Qakilahe-kalan*.

This plant is found wild in the mountainous parts of India and Nepal. In Bengal, a kindred variety *Amomum aromaticum* is found. The fruits are almost the size of the nutmeg and are cheap and efficient substitutes for the true cardamom. They are commonly sold in bazars by shopkeepers. An oil extracted from the seeds of *A. subulatum* rich in cineole is used for flavouring purposes. Both in the indigenous and Western medicine, cardamom is used as a frequent adjunct to other stimulants, bitters and purgatives, in the form of tincture or powder.

References:—

Finnemore, 1926, *The Essential Oils*.

EPHEDRA VULGARIS (N.O. Gnetaceæ)
and Allied Varieties

VERN.—Punj.—*Amsania, Butshur, Chewa*.

Few drugs of recent years have attracted so much attention of the medical profession as *ephedrine*, the alkaloid from

E. vulgaris, the Chinese plant *Ma Huang*. A considerable volume of experimental work has been done on this subject and a well compiled bibliography by Professor B. E. Read will interest those who wish for further details. The drug has been in use in China for the last five thousand years. The habitat of ephedra, however, is not confined to China but has a much wider geographical distribution. Liu has shown that it is scattered widely all over the world. In India a number of species grow abundantly in the drier regions of the Himalayas. A few species of ephedra also grow in the plains but these contain little or no alkaloid.

The plant has not been used in the indigenous medicine in this country. Although according to Aitchison some parts of *E. vulgaris* are used *medicinally in Lahoul*, the *drug is not mentioned in the* Ayurvedic (Hindu) or Tibbi (Mohammedan) medicine. It is said that one variety of ephedra, probably *E. intermedia*, is the famous 'soma' plant from which the favourite drink of the Rishis (ascetics) of the Vedic period was prepared, but there is little evidence to support this statement. The gradually increasing use of ephedrine in therapeutics and its high price induced the author (1926) to explore the resources of the Indian varieties of ephedra and to study their chemical composition, pharmacological action and clinical uses. As the retail price of ephedrine at present is about 600 rupees per pound, the sister alkaloid pseudo-ephedrine was carefully investigated in order to see if any use could be made of it in therapeutics.

Watt (1890) described three species of ephedra growing in India.

1. *Ephedra vulgaris*, Rich. (Fl. Br. India), also known as *E. gerardiana*, Wall., *E. distachya and E. monostachya*, Linn.; it is known in the vernaculars by the names *amsania, chewa, butshur, khanda, khama, kunawar* or *phok* in different parts of India.

It is a small, low growing, rigid shrub which occurs throughout the Himalayas. It grows in abundance in the dry, stony regions of the temperate and Alpine Himalayas extending from Western Tibet to Sikkim. On the Shalai Hills, north of Simla, it occurs in large quantities at an altitude close on 10,000 ft.

2. *Ephedra pachyclada*, Boiss., also known as *E. intermedia*, Schrenk and Meyer. It is known as *huma* in Persia, *gehma* in Bombay and *oman* in Pushtu. It is a tall shrub found in the dry stony regions of the Western Himalayas and Western Tibet.

3. *E. peduncularis*, Boiss., also called *E. alte*, Brand, *E. alata*, Meyers. It is known in the vernacular as *kuchan, nikkikurkan, bratta, tandala, lastuk, mangarwal, bandukai*. It is a tall scandent shrub with slender branches which grows on stony ground in Sind, the Punjab and Rajputana.

Besides these three varieties described by Watt, two more of lesser importance grow in various parts of India. They are (1) *E. foliata*, Boiss., (Fl. Orient) and (2) *E. fragilis* (Flowering Plants of Baluchistan, I. H. Burkhill).

Brandes (*Indian Trees*, 1906) recognised 5 species occurring in India. These are:—(1) *E. foliata*, Boiss., (2) *E. gerardiana*, Wall., Syn. *E. vulgaris*, Hook., (*Flora of British India*), (3) *E. nebrodensis*, Tineo., (4) *E. intermedia*, Schrenk and Meyer and (5) *E. pachyclada*, Boiss. Of these, *E. nebrodensis* does not seem to differ much from *E. gerardiana* by any well marked characters and is sometimes included in the latter. Similarly, *E. pachyclada* is considered synonymous with *E. intermedia*. Botantists of the Forest Research Institute, Dehra Dun, however, regard *E. nebrodensis* a separate species from *E. gerardiana*. *E. nebrodensis* occurs in the Juniper tracts of Baluchistan 7,000 to 10,000 feet above the sea level and also in Baltistan and Lahoul.

All these varieties occur in various places in Northern India—Bashahr Division, Chakrata, Kangra, Kulu, Baluchistan Kashmir, Hazara, Kagan, Trans-Frontier territory, Waziristan, etc. Specimens from various places have been analysed and it has been shown that ephedras growing in the drier regions of North-West India contain a high percentage of the alkaloids, in many cases higher than the alkaloidal content of Chinese species recorded by Read and Feng. Among the Indian species *E. nebrodensis* is the richest and *E. intermedia* the poorest so far as its ephedrine content is concerned. In Indian ephedras the alkaloid content does not increase with the altitude of the locality where the drug grows, but is influenced to an appreciable extent by the rainfall of the locality.

Chopra and his collaborators (1929) describe two varieties growing side by side on the mountain ranges bordering on the Jhelum valley. These varieties are of special interest on account of their

high alkaloidal yield. The proportion of ephedrine and pseudo-ephedrine, however, in the two varies greatly :—

1. *E. vulgaris* or *E. gerardiana* is known in the vernacular as *Janusar*. It is a low rigid nearly erect shrub, usually 1 to 2 feet in height. It occurs also in *Hariab* district, Kurram valley (at an altitude of 1,000 feet), Himalayas (at an altitude of 8,000 to 14,000 feet) also in the inner tracts ascending in Sikkim to an altitude of 16,500 feet above the sea level. It has an alkaloidal content of 0.8 to 1.4 per cent., of which about half is ephedrine and the balance is pseudo-ephedrine. It may also be noted here that there are marked variations in the alkaloidal content of the green twigs and the stems of these varieties. The alkaloidal content of the green twigs of the Indian *E. vulgaris* is about four times that present in the stems and that of *E. intermedia* nearly six times.

2. *E. intermedia* var. *tibetica* is known in the vernacular as *hum* (Trans-Indus). It is a small erect shrub. It occurs in the inner valleys of Chitral at an altitude of 4,000 to 5,000 feet on the dry rocky slopes, in Gilgit, Zauskar, Upper Chenab, Kunwar (at 6,000 to 9,000 feet) and also in Baluchistan. The variety *tibetica* gives an alkaloidal content ranging from 0.2 to 1.0 per cent., of which 0.025 to 0.056 is ephedrine and the remainder is pseudo-ephedrine.

E. gerardiana and *E. intermedia* are sometimes confused with *E. equisetina* which is a non-flowering plant, but the latter is never woody, its stems are hollow and the leaves are more numerous, and at the apex embrace the internodes not to the area from which they arise.

The berries, roots, woody stocks and branches were found to contain very little ephedrine. The green stems are the only parts which give the highest amount of the alkaloids. The collection of the drug in the autumn before the winter frost sets in, is essential to get a good yield of alkaloid.

E. foliata, Boiss., vern. *kuchar*, grows in Baluchistan, Sind, Kurram valley, the Punjab plains, mainly in the southern portions, and the Salt Range up to 3,000 ft. It contains no alkaloid.

Chemistry of Ephedrine and Pseudo-ephedrine :—E p h e d r i n e, $C_{10}H_{15}ON$, is a colourless crystalline substance, M.P. 41—42°C. The hydrochloride forms colourless needles, M.P. 216°C; specific rotation in water is −34.2° and in absolute alcohol −6.81°. The platinichloride of the base crystallizes in colourless needles, M.P. 186°C.

Pseudo-ephedrine or *iso-ephedrine* $C_{10}H_{15}ON$, occurs with ephedrine in *Ephedra gerardiana* and *E. intermedia* and is formed by heating ephedrine with hydrochloric acid. It is a dextro-rotatory isomer of ephedrine with a specific rotation of +50° in absolute alcohol and crystallizes from ether, M.P. 118°C.

The base is a white, colourless, crystalline substance occurring in the form of long needles freely soluble in alcohol. The hydrochloride forms colourless needles M.P. 179°C. It forms a remarkably soluble oxalate in contrast to the sparingly soluble ephedrine oxalate. The oxalate of ephedrine crystallizes from water in fine needles sparingly soluble in water and less so in alcohol. This relative insolubility of ephedrine oxalate provides a fairly simple means of separating the alkaloid from the associated isomer d-pseudo-ephedrine.

The ratio of ephedrine to d-pseudo-ephedrine seems to vary with the different species, the real value of the herb being determined by a high γ-ephedrine content. The alkaloid ephedrine can exist in no less than six forms :— γ-ephedrine, d-ephedrine, dγ-ephedrine, γ-pseudo-ephedrine, d-pseudo-ephedrine and dγ-pseudo-ephedrine.

After the separation of the alkaloids, γ-ephedrine and d-pseudo-ephedrine, there remains a small precipitate of oily residue which is still high in alkaloid content. From this oily residue Sydney Smith has separated two additional alkaloids γ-methyl ephedrine and nor-d-pseudo-ephedrine. γ-methyl ephedrine was prepared by distilling the oily residual alkaloids under reduced pressure and purified through the alcohol soluble oxalate, γ-methyl ephedrine has an optical rotation $[\alpha]_D = -29.2°$

The alkaloids γ-ephedrine and d-pseudo-ephedrine are not particularly sensitive to potassic mercuric iodide solution. On the addition of that reagent to a 1 per cent. neutral solution of the sulphates of the alkaloid no precipitate occurs. Both alkaloids are precipitated in a 3 per cent. neutral solution but the precipitate is readily soluble in dilute acids. To the same reagent γ-methyl ephedrine and dγ-pseudo-ephedrine behave in marked contrast to the above. They are readily precipitated from a 1 per cent. neutral solution of the sulphates, the precipitate remaining undissolved on the addition of dilute acid.

Probably the most important property of ephedrine is its stability; its solutions are not decomposed by light, air or heat, and age apparently does not affect their activity. Thus a solution of ephedrine hydrochloride, prepared and sealed in a sterile ampoule for 6 years, showed no change in appearance and produced the customary pressor response when injected into a pithed cat. Kendall and Witzmann (1907) have demonstrated the great resistance of ephedrine to oxidation as compared with epinephrine; the former is not oxidised by dibromophenolindophenol, methylene blue or indigo carmine, whilst the latter is oxidised by all these reagents. Pseudo-ephedrine hydrochloride is also very stable; a 1 per cent. solution still retains its properties after keeping at room temperature for many weeks and it is believed may keep indefinitely without deterioration. Its solutions can be boiled without decomposition. Mixing with sera does not interfere with the activity of either ephedrine or pseudo-ephedrine, even after incubation for many hours.

Export of Ephedra:—The different species are so closely allied in their botanical characters that only a chemical analysis can show their value as a commercial article. There is every possibility of adulteration of the best specimens with the lowest grade without fear of detection. Ephedrine is a drug of great therapeutic value. If some sort of control is not exercised over the collection as well as the careful selection of the drug, Indian ephedra will have little chance of competing with the drug obtained from Chinese or other sources in the foreign market. Work carried out by Chopra and his co-workers and Krishna and Ghosh in this country has undoubtedly established the commercial values of *E. gerardiana* and *E. nebrodensis* and has shown that the Indian species are quite as rich in ephedrine content, if not in some cases richer, as the Chinese species. Already a demand for Indian ephedras has been created in India and elsewhere. It is difficult to get exact statistics of the exportation of any particular drug material because drugs are generally classed together in the customs returns. At a conservative estimate it may be said that about 2,000 maunds of ephedra were exported from India during 1928-29. These figures represent only a portion of the trade which has recently been developed in China. The figure for export from the whole of China is about 8,000 maunds a year.

Distribution of Indian Ephedras:—The following table shows the distribution of various species of ephedra growing in India.

TABLE I

Indian Ephedras

Species	Locality	Authority	Remarks
Ephedra foliata	Bombay and Plains of Sind, Salt Range up to 3,000 ft., Punjab, Rajputana, often gregarious, etc., on the barren desert	Forest flora of Bombay Presidency and Sind by Talbot, Vol. II, p. 541	

Species	Locality	Authority	Remarks
E. pedunculalis (*E. foliata*)	Punjab, Rajputana and Sind	Flora of British India by Hooker, J., Vol. V, pp. 640 and 863	
E. intermedia, Schrenk and Meyer	Kashmir	Flora of British India by Hooker, J., p. 863	
E. vulgaris, Rich.	N. W. Dry stony hills of Afghanistan, Baluchistan, inner arid and intermediate Himalayas, Jhelum, Chenab and Sutlej 7,800 to 12,800 ft., West Tibet to 16,000 ft. ; inner Kumaon and inner Sikkim and adjoining parts of Tibet	Forest flora of N. W. and Central India by Brandis	Syn. *E. gerardiana*
E. gerardiana	Kumaon. Occurs along the main Himalayan range between 6,500 ft. to 14,000 ft. Very common on the inner dry ranges bordering Tibet where it grows on open exposed shingly slopes or among rocks	A Flora of Kumaon by Osmaston	Syn. *E. vulgaris*
Do.	North Garhwal Divn., C. Almora, E. Almora. Very common	Descriptive list of Trees and Shrubs between the Ganges and the Sarda Rivers by Osmaston	
Do.	Alpine Himalayas and Western Tibet and Sikkim	Flora of British India by Hook, F., Vol. V, pp. 640 and 863	
	Temperate and Alpine Himalayas and Western Tibet in the drier regions 7,000 to 12,000 ft. ; 12,000 to 16,000 ft. in Sikkim		

Species	Locality	Authority	Remarks
E. gerardiana, Var. *allichii*	Western Tibet, Kunawar, Garhwal and Kumaon	Flora of British India by Hooker, Vol. V, pp. 640 and 863	
Var. *β-saxalilia*	Garhwal and Kumaon	Do.	
Var. *γ-sikkimensis*	Sikkim	Do.	
E. nebrodensis, Tineo, Var. *procera*	Lahoul and Western Tibet	Do.	Usually classed with *E. gerardiana*
E. pachyclada	Garhwal. From Garhwal westward ascending to 15,000 ft.	Do.	Syn. *E. intermedia*
Var. *glauca*	Mongolia to Kashmir	Do.	
Var. *tibetica*	Afghanistan border, Western Tibet, Afghanistan	Do.	
	Behar and Orissa	Botany of Behar and Orissa by Baines	Ephedras not found
	Northern Berar Forests	Descriptive Botanical list	Do.
	Northern Berar Forests	Descriptive Botanical List, Northern and Berar Forest Circles, C. P., by Witt	Do.
	Central Provinces	Descriptive List of Trees, Shrubs and Economic Herbs of the S. C. C. P., by Haines	Do.
	Chota Nagpur	A Forest Flora of Chota Nagpur, by Haines	Do.

Species	Locality	Authority	Remarks
E. pachyclada Var. *tibetica*	Gangetic Plains	Flora of the Upper Gangetic Plain, Pts. I, II and III, by Duthie	Ephedras not found
	Chittagong and Hill Tracts	List of Plants of the Chittagong and Hill Tracts, by Heinig	Do.
	Darjeeling Dist.	Trees, Shrubs and large Climbers found in the Darjeeling District by Gamble	Do.
	Bengal	Bengal Plants by Prain	Do.
	Upper Assam and Khashi Hills	Preliminary List of Plants of Upper Assam including Khashi Hills by U. N. Kanjilal	Do.
	Nilgiri and Pulney Hill tops	The Flora of the Nilgiri and Pulney Hill tops by Pyson	Do.

Variation of the Alkaloid due to Species:—Read and Liu (1928) have pointed out that, the distribution of ephedra in the world is fairly wide. Many species of this plant are known, but the active principle is found only in a few. The American species usually do not contain any ephedrine, the European plant yields an isomeric substance pseudo-ephedrine, the Chinese and the Indian species contain both ephedrine and pseudo-ephedrine ; the amount of any one of the two alkaloids depends upon the species. A detailed study of the Indian ephedras has been made by the author in collaboration with Krishna and Ghosh of the Forest Research Institute, Dehra Dun and their

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results have been recorded in Tables II and III. Table II gives the total alkaloid and the ephedrine percentage of three common species collected from different localities at about the same time of the year. It is unfortunate that figures for all the samples are not available for the months of October and November, when the ephedrine content is highest. Most of the samples recorded in Table III were obtained from private collectors and for the sake of convenience the months from June to September were chosen. These months, however, do not give the ideal conditions for comparison, as the influence of rainfall on the alkaloid cannot be neglected, especially in localities (Chakrata) where the rainfall in these months is high. This point has been discussed more fully elsewhere.

TABLE II

Species	Locality of Collection	Month of Collection	Total Alkaloids per cent.	Ephedrine per cent.
Ephedra foliata	...	...	0·03	*nil*
E. intermedia	Razmak (Waziristan) ...	Aug. 1928	0·17	0·11
	Datakhel Do. ...	Sep. 1928	0·12	0·09
	Shingarh (Baluchistan) ...	Sep. 1929	0·42	0·19
	Zarghat (Baluchistan) ...	Sep. 1929	0·90	0·48
	Pangi (Bashahr) ...	July 1929	1·62	0·07
	Spiti (Kangra)	June 1929	1·20	0·05
	Gilgit (Kashmir) ...	July 1929	0·67	...
	Niabat Astor (Kashmir) ...	July 1929	0·75	0·08
	Kargil (Kashmir) ...	July 1929	1·17	0·05
	Chini Range (Bashahr Div.)	May 1929	2·33	0·38
E. gerardiana and E. nebrodensis	Razmak (Waziristan) ...	May 1929	1·97	1·43

Species	Locality of Collection	Month of Collection	Total Alkaloids per cent.	Ephedrine per cent.
E. gerardiana and E. nebrodensis	Shahidum (Baluchistan) ..	Aug. 1929	1·40	0·98
	Sari Do. ...	Aug. 1929	1·31	0·90
	Shingarh Do. ..	Aug. 1929	1·67	1·12
	Zarghat Do. ...	Sept. 1929	1·34	0·96
	Narang (Kagan) ...	Aug. 1929	1·93	1·30
	Dhattamulla (Kashmir) ...	Aug. 1929	1·22	0·68
	Phari (Tibet Frontier) ...	Nov. 1928	0·29	0·10
	Chakrata	Nov. 1929	0·93	0·72
	Hazara	May 1928	0·74	0·48
	Baramulla (Kashmir) ...	Nov. 1929	1·28	0·80
	Lahoul	Oct. 1929	2·79	1·93
	Plas Kohistan (Trans-Frontier)	Sep. 1928	1·14	0·84
	Kagan valley	July 1928	1·83	1·23
	Kagan	Oct. 1929	2·15	1·52
E. equisetina	China	...	1·58	0·98
E. sinica	China	..	1·28	0·63

TABLE III

Locality	Altitude in feet	Species	Month of Collection, 1929	Total Alkaloids per cent.	Ephedrine per cent.	Percentage of Ephedrine in Total Alkaloids
Spiti (Kangra)	8,000-9,000	*Ephedra intermedia*	June	1·20	0·05	4·1
Gilgit (Kashmir)	4,890	,,	July	0·67	...	...
Niabat Astor (Kashmir) ...	7,836	,,	,,	0·75	0·08	10·6

Locality	Altitude in feet	Species	Month of Collection, 1929	Total Alkaloids per cent.	Ephedrine per cent.	Percentage of Ephedrine in Total Alkaloids
Pangi (Bashahr Div.)	8,500	*Ephedra intermedia*	July	1·62	0·07	4 3
Kargil (Kashmir)	8,733	,,	,,	1·17	0·05	4 2
Shingarh (Baluchistan) ...	9,000	,,	Sept.	0·42	0·19	45·2
Zarghat (Baluchistan) ...	8,000	,,	,,	0·90	0 48	53·3
Razmak (Waziristan)	8,500	*E. nebrodensis*	July	1·70	1·05	61·7
Shahidum (Baluchistan) ...	8,200	,,	Aug	1·40	0·98	70·0
Sari Do. ...	9,000	,,	,,	1·31	0·90	68·7
Shingarh Do. ...	9,000	,,	,,	1·67	1·12	67·0
Zarghat Do. ...	8,000	,,	Sept.	1·34	0·96	71·6
Kardung (Lahoul) ...	10,000	,,	July	2·56	1·63	63·6
Narang (Kagan) ...	8,000	*E. gerardiana*	Aug.	1·93	1·30	67·3
Dhattamulla (Kashmir) ...	4,700	,,	,,	1·22	0·68	55·7
Chakrata ...	6,885	,,	,,	0·28	0·14	50·0

From these, it is clear that the variation of the alkaloid in the three species is very marked. The difference is not so great, so far as the total alkaloid is concerned, but it is well marked in the proportion of ephedrine to the total alkaloids. In general, *E. nebrodensis* and *E. gerardiana* appear to contain about 60 to 70 per cent. of ephedrine in the total alkaloids and *E. intermedia* about 10 per cent. The only exception to this is the *E. intermedia* obtained from Baluchistan, which contains a comparatively low percentage of the total alkaloids but a

high proportion of ephedrine. *E. intermedia* contains, as a rule, a proportionately high percentage of pseudo-ephedrine. The proportion of ephedrine in total alkaloids, as recorded here, is slightly different from that obtained by Read and Feng for Indian ephedras, where *E. intermedia* is shown to contain 30 to 40 per cent. of the total alkaloids. This difference may be explained as due to different methods of estimating the amount of ephedrine. The percentage of ephedrine given here is based on the weight of ephedrine hydrochloride actually isolated from the crude plant and not on the probable percentage of the base indicated by the biuret reaction, developed by Read and Feng. For purposes of comparison, the quantities of alkaloids found in the Indian, Chinese, American and African ephedras are given in Table IV.

TABLE IV

Country	Species	Total Alkaloids per cent.	Ephedrine per cent.	Pseudo-ephedrine per cent.
Indian ...	*E. foliata*	0·03	*nil*	*nil*
	E. intermedia	2·33	0·40	1·8
	E. gerardiana	2·15	1·52	...
	E. nebrodensis	2·79	1·93	...
Chinese ...	*E. sinica* .. .	1·315	1·118	0·263
	E. equisetina	1·754	1 579	0·264
American ...	*E. nevadensis*	..	*nil*	*nil*
	E. trifurca	...	*nil*	*nil*
	E. californica	0·014	*nil*	*nil*
African ...	*E. alata*	...	-	1·0

Effect of Altitude:—In the case of Chinese ephedras, it has been shown that the ephedrine contents vary with the

altitude of the locality where the ephedras grow. Recent investigations by the author in collaboration with Krishna and Ghosh, on ephedras collected from different localities in India, however, have brought out certain new facts which do not agree with the findings recorded in the case of Chinese ephedras. From a reference to Table III, it will be seen that samples of *E. nebrodensis* collected from two different localities (Sari and Shingarh in Baluchistan) situated at an altitude of about 9,000 ft. above the sea level show widely different figures (0.90 to 1.12 per cent.) so far as their ephedrine content is concerned. Samples of *E. gerardiana* from Dhattamulla (Kashmir) show an ephedrine content of 0.68 per cent. whereas same variety of ephedra collected from a different locality (Chakrata) situated at a higher level (6,885 ft.) show a lower ephedrine content. The altitude, therefore, has no apparent connection with the ephedrine content of Indian ephedras.

Effect of Rainfall:—Another interesting feature of the Indian ephedras is that the rainfall of the locality where the ephedras grow bears a distinct relationship with the ephedrine content of the plant. The greater the annual rainfall the smaller is the alkaloidal content. Not only does the annual rainfall affect the average ephedrine content, but an occasional heavy shower lowers the ephedrine content considerably. Such cases have been observed in many places, for instance in Kagan in Hazara where the collection of the drug was made in September after a continuous heavy rainfall, and in consequence, it showed a very low ephedrine content. Similarly, in Chakrata the cumulative effect of heavy rainfall in July and August is marked by a lower percentage of ephedrine in the August and September collections. In places like Kagan and Lahoul, where the snowfall takes place early in November, the maximum ephedrine content is attained in October; on the other hand in places like Chakrata, Baramulla and Chini, the maximum is reached in November. In the table below the effect of rainfall on the ephedrine content of Indian ephedras is given.

TABLE V

Locality	Average Annual Rainfall Inches	Average Total Alkaloids per cent.	Average Ephedrine per cent.
Kagan	3—10	1 90	1 20
Razmak ..	20	1 46	0 90
Kashmir	32	1 15	0 65
Baramula ...	45	0 90	0 52
Chakrata ..	75	0 63	0 45

Seasonal Variations:—It has moreover been noticed that the amount of ephedrine found in the ephedras varies with the time of the year when the collection is made. To study the seasonal variation of the alkaloidal content in ephedras, monthly collections of the three species were obtained from different localities in India, and assayed. The collection was made first in the month of April, when the plant brings out new shoots, and was carried on through the months when it flowers, till its maturing period in October and November, after which it begins to show signs of withering.

Read (1928), from his experiments on Chinese ephedras, has concluded "that there is a progressive increase in the content of ephedrine in *E. sinica* and *E. equisetina*, so that from spring to autumn there is an increase of about 200 per cent. This strongly supports the old Chinese custom of collecting the drug in the autumn". From the results of assays done, by Chopra and Dutt (1930) on Kashmir ephedras and Chopra, Krishna and Ghosh (1931) on ephedras derived from various localities in India, it is evident that the variation of the alkaloids from April to November in the Indian ephedras is not so great, nor is the variation so uniform and regular with each month, as shown by Read. In all the specimens analysed, the ephedrine content decreases beginning with the month of May and steadily goes down during the rainy months till it reaches the lowest point in August, *i.e.*, at the end of the rainy season.

From this point onwards, the alkaloid increases till it reaches its maximum in the autumn months, *i.e.*, October and November and then it falls again during the cold months. The fall in the alkaloidal content from May to August in Indian ephedras cannot be attributed to anything except the climatic conditions.

Effect of Storage :—A point of industrial interest that has also been studied is the effect of storage on the ephedrine content of the drug. From the results of the analyses given in table VI it appears that if the drug is thoroughly air-dried and stored in a dry place to prevent bacterial growth, it can be kept for a sufficiently long period without any diminution in its ephedrine content.

TABLE VI

The Effect of Storage on the Ephedrine Content of Ephedras

Description	Date of collection	Date of analysis	Total alkaloid per cent.	Ephedrine per cent.
E. intermedia from Chini	Nov. 1928	March 1929	2.08	0.50
		Dec. 1929	1.99	0.48
E gerardiana from Kashmir	June 1928	Aug. 1928	0.86	0.55
		June 1929	0.76	0.47
		Dec. 1929	0.83	0.50
Do.	Oct. 1928	Nov. 1928	0.93	0.63
		June 1929	1.01	0.67
		Dec. 1929	0.92	0.60

Ephedrine in other Indian Plants :—Chopra and De (1930) have shown the presence of a sympathomimetic alkaloid in *Sida cordifolia* whose pharmacological action closely resembled that of ephedrine and they thought that the alkaloid was undoubtedly ephedrine. Later, Ghosh and Dutt (1930) have shown that the sympathomimetic alkaloid referred to above showed all the chemical and physical characteristics of

ephedrine. This plant is distributed throughout the tropical and sub-tropical India and Ceylon, growing wild along the roadside. The roots, leaves and seeds are all used in the Hindu medicine as a stomachic and as a cardiac tonic. The whole plant (including leaves, seeds, stems and roots) contains the alkaloid to the extent of 0.085 per cent. The seeds contain much larger quantities, *i.e.*, 0.32 per cent. The interesting point about this work is the occurrence of ephedrine in two entirely different divisions of the vegetable kingdom; the ephedras belong to the divisions of Gymnosperms while *Sida cordifolia* belongs to Angiosperms.

Chopra and De (unpublished) have also found the presence of a sympathomimetic alkaloid resembling ephedrine in *Moringa pterygosperma* (vern. Sajina) and it will be interesting to see when their results are published if it is really ephedrine or some other alkaloid.

Pharmacological Action of Ephedrine and Pseudo-ephedrine from Indian Ephedra:—After its discovery in about 1887, ephedrine received a great deal of attention from the chemical point of view, but besides its mydriatic actions noticed by the Japanese investigator Nagai, no advance was made so far as its action is concerned. In 1924 Chen and Schmidt published their paper on the pharmacological action of ephedrine and demonstrated its close physiological as well as clinical relationship to adrenaline. The action of ephedrine and pseudo-ephedrine, obtained from the Indian varieties of ephedra, has been fully worked out by the author and his co-workers. The action of the ephedrine has been found to be the same as that obtained from the Chinese plant which has been studied in great detail by various workers. Very little attention has however been paid to pseudo-ephedrine and as this is the alkaloid which occurs abundantly in the Indian varieties of ephedra, it was carefully studied by the author and his co-workers.

It was shown that pseudo-ephedrine stimulates both the inhibitory and the accelerator mechanisms of the heart and has a stimulating influence on the myocardium. The rise of blood pressure is not so great as in the case of ephedrine and is only partly due to sympathetic stimulation as it is still produced when the sympathetics are paralysed with ergotoxin. The occurrence of the rise after the vaso-motor fibres are paralysed shows that the alkaloid stimulates the unstriped muscle fibres of the blood vessels, and that the cardiac muscle is markedly stimulated.

The rise of blood pressure is considerable in such animals as the cat with such doses as 2 mgm. and persists for from 20 to 30 minutes.

Repetition of injections does not evoke an equally great response, the height of the pressor effect being gradually diminished as the number of injections increases.

The pulmonary pressure shows a marked rise, the action resembling that of adrenaline. This is one of the most constant effects of the drug. The rise appears to be due to contraction of the branches of the pulmonary artery and this also relieves the turgescence of the mucous membrane. There is at the same time a well-marked dilatation of the bronchioles and both these factors help in relieving the paroxysms of asthma. If in experimental animals an asthma-like condition is produced by giving an injection of pilocarpine, the marked spasm produced is relieved immediately by an intravenous injection of 2 mgm. of pseudo-ephedrine showing that the drug has a powerful bronchodilator effect.

The sympathomimetic action of this alkaloid is also clearly shown by the fact that immediately after an injection of 2 mgm. of pseudo-ephedrine, the movements of the gut are inhibited and there is a well-marked relaxation of the intestines. Perfusion of an isolated piece of the ileum of the rabbit shows a similar effect. Movements of the uterus of the cat *in situ* as well as of the isolated uterus in a uterine bath show marked inhibition and may stop altogether. Injection of 2 mgm. of pseudo-ephedrine produces a persistent rise of blood pressure accompanied by a marked contraction in the size of the spleen resembling that obtained by adrenaline.

The volume of other abdominal viscera such as the kidneys shows an increase after an injection of the drug. These effects are produced by a general rise of blood pressure all over the body by the vaso-constricting action of the drug which forces the blood into the splanchnic area. It is also to be noted that the increase in the volume of the kidney corresponds to the increase in the systemic blood pressure; when this falls to normal, the kidney volume also becomes normal.

The increase in the volume of the kidney suggested that the alkaloid might have a diuretic action; the urine flow was, therefore, measured by putting a cannula into the ureters, the drops of urine emerging being recorded on the drum by an electro-magnet. The rate of secretion is markedly increased and it was also noted that the acceleration of the urine flow lasted as long as the blood-pressure effect lasted.

Difference in the Action of Ephedrine and Pseudo-ephedrine :—From the experimental data collected, it is evident that the action of pseudo-ephedrine closely resembles that of ephedrine. Both the alkaloids pass through the liver unchanged and produce their usual effects whether injected into

one of the mesenteric veins or into a systemic vein. They are both rapidly absorbed from the gastro-intestinal tract and their inhibiting effect on the musculature of the gut is about equal. Both the alkaloids produce a contraction of the blood vessels and a well-marked rise of blood pressure. The vasopressor effect is much stronger in case of ephedrine which acts almost entirely on the vasomotor nerve endings, while pseudo-ephedrine has been shown to have some action on the musculature of the vessels as well. The rise of pressure is also less marked in the pulmonary and portal areas with pseudo-ephedrine. Its dilator action on the bronchioles as well as its contracting action on the mucous membrane of the nose does not essentially differ in its potency from that of ephedrine. The effect of the two alkaloids on the kidney is to produce a dilatation of the blood vessels and an increase of the kidney volume, but the initial momentary constriction produced by ephedrine is absent in case of pseudo-ephedrine; the diuretic effect is much more marked in the case of the latter alkaloid. The action of the two alkaloids on the voluntary and involuntary muscles appears to be about equal.

Therapeutic Uses of Indian Ephedra:—It has been already remarked that the pseudo-ephedrine content of many of the Indian species of ephedra is high. The yield of ephedrine from various varieties in many cases does not exceed 50 per cent. of the total alkaloids and is often considerably less. The price of the alkaloid is now about Rs. 600 per pound and even at that sufficient quantities are not available. Some of the Indian varieties contain much larger quantities of pseudo-ephedrine than ephedrine. In view of these facts we tried to see how far it was possible to substitute pseudo-ephedrine for ephedrine in therapeutics.

Ephedrine and Pseudo-ephedrine in the Treatment of Asthma:—From the time the sympathomimetic action of ephedrine was discovered this alkaloid has been very extensively used in the treatment of asthma. The relief afforded by it, though not quite so instantaneous as adrenaline, is quick and certain; besides it can be taken by the mouth and need not be given by injection. It has, therefore, been used

indiscriminately in a large number of cases with sometimes untoward results. We have known patients who have been in the habit of taking half a grain of the alkaloid twice a day for many months. In our asthma clinic at the Calcutta School of Tropical Medicine, our experience with the use of this alkaloid in the treatment of this symptom complex has not been altogether satisfactory. It undoubtedly controls the paroxysms and relieves the symptoms in a quarter of an hour to half an hour, but it is likely to produce unpleasant side effects. In some patients acute pain in the cardiac region lasting for 10 to 20 minutes has been observed and a feeling of distress in the pericardium is not an uncommon symptom in a large number of patients using the drug, owing to hypertension produced by stimulation of the vaso-motor nerve-endings. Some patients get palpitation, flushing of the skin and tingling and numbness of the extremities; tachycardia and fainting fits may be produced. Patients, suffering from inflammatory conditions of the skin, frequently get exacerbation after its use and quiescent conditions may become acutely active. Those suffering from organic disease of the heart, especially of the myocardium, get decompensation, probably owing to the depressant action on the heart muscle by excessive dosage.

Besides this, the stimulating action of the alkaloid on the sympathetic is liable to produce persistent constipation, which aggravates certain types of asthma. Loss of appetite frequently occurs and digestive disturbances are not infrequent accompaniments. This drug has not been sufficiently long in use for us to know all its untoward and toxic effects, but they undoubtedly do exist. Caution is, therefore, recommended in its use, especially for prolonged periods in the treatment of such a symptom complex. Often the relief afforded is of short duration and there is temptation of repeating the drug. Its routine use in controlling the paroxysms without investigating the cause is to be strongly deprecated.

We have already pointed out that the pressor action of pseudo-ephedrine is much less powerful than that of ephedrine but its broncho-dilator action appears to be quite as

marked. The contraction of the branches of the pulmonary artery relieves the turgescence of the mucous membrane and this with the well-marked dilatation of the bronchioles helps in relieving the paroxysm. We have tried pseudo-ephedrine in the treatment of this condition with excellent results. Within 15 minutes to half an hour of oral administration of ½ grain of the alkaloid, the feeling of tightness round the chest is relieved and the patient's breathing becomes normal. A similar dose taken when the premonitions of an attack are felt generally stops the paroxysm. The effect in fact is just as rapid as that of ephedrine. Although we have not tried it on a sufficiently large scale and for long enough periods, the results so far have been encouraging and the side effects produced are not so unpleasant. If use of this alkaloid is extended in the treatment of asthma and other conditions in which ephedrine is being used, not only will the cost of treatment be reduced but it may be possible to avoid the unpleasant side effects of the latter drug.

Alcoholic Extract or Tincture Prepared from Indian Ephedra:—An extract prepared from *E. gerardiana* and *E. intermedia*, first introduced by the author, has now been in use for nearly three years. It is prepared by exhausting the dried powdered twigs of the plant with 90 per cent. alcohol, sufficient water being then added to make the strength of alcohol about 45 per cent. 5.0 c.c. of the extract should contain ½ grain of the total alkaloids. This extract can be used either by itself or in combination with asthma mixtures and is very effective in controlling asthmatic paroxysms. It is considerably cheaper than the purified alkaloids and brings the use of this drug within the means of poor people. A weaker tincture is also on the market now.

Ephedrine and Pseudo-ephedrine as Cardiac Stimulants:—The stimulant action of these alkaloids on the blood pressure is well-known and for this reason they have been used as cardiac stimulants. We have already pointed out that while ephedrine, especially in large doses, has a depressant action on the myocardium, pseudo-ephedrine on the other hand has the opposite stimulant action on the heart muscle. Besides

its action on the vaso-motor nerve endings the latter alkaloid also stimulates the muscle fibres of the arterioles. The author has, therefore, tried an extract of ephedra which contains both ephedrine and pseudo-ephedrine (more of the latter) as a cardiac stimulant with encouraging results. This produced a well-marked beneficial effect when administered to patients in whom the action of the heart was weak and compensation was failing. Observations on a number of patients showed that there was a definite rise of blood pressure amounting to 10 to 20 mm. of mercury, after ½ to 1 drachm doses, 2 or 3 times a day. Marked diuresis was produced in those patients in whom the function of the kidneys was disturbed from inefficient circulation.

Epidemic Dropsy :—As is well-known, the heart is seriously affected in this condition and gives rise to such subjective symptoms as dyspnœa, palpitation, præcordial pain and even cardiac asthma. The rate of heart beat is accelerated from the very beginning of the disease. The first sound at the apex becomes short and sharp and later it becomes muffled; often the first sound is reduplicated. Later, a systolic murmur may be present at the apex due to dilatation of the heart producing mitral incompetence and sometimes a hæmic murmur is also audible at the pulmonary base. A presystolic murmur may be heard. In such cases digitalis gives unsatisfactory results; in fact some of the patients actually become worse. A number of other cardiac stimulants proved ineffective. In cases of left heart failure, the tincture of ephedra proved very effective. The patient felt relieved and the symptoms disappeared.

Other Cardiac Conditions :—The tincture of ephedra is also an excellent cardiac stimulant in toxic conditions of the heart produced by such infections as pneumonia, diphtheria, etc. Lt.-Col. Vere Hodge, I.M.S., tried the tincture in ½ drachm doses, 3 to 4 times daily with excellent results in such conditions.

References :—

(1) Chopra and others, 1928, *Ind. Jour. Med. Res.*, Vol. XV, April; (2) Chopra and Dutt, 1930, *Ind. Jour. Med. Res.*, Vol. XVII,

Jan.; (3) Chopra and Basu, 1930, *Ind. Med. Gaz.*, Vol. LXV, Oct.; (4) Krishna and Ghose, 1931, *Indian Forest Records;* (5) Chopra, Krishna and Ghosh, 1931, *Ind. Jour. Med. Res.*, Vol. XIX, July, pp. 177—219; (6) Vere Hodge, 1931, *Ind. Med. Gaz.*, Vol. LXVI, Dec.

ERYTHROXYLON COCA (N.O. Lineæ)

The alkaloid cocaine derived from this plant is a very valuable drug in medicine. The plant grows to a height of 6 to 8 feet, the leaves are of a lively green tint, thin, opaque, oval and slightly tapering at the extremeties. It thrives best in hot and damp localities, but the leaves most preferred for medicinal purposes are grown in drier climates. The original home of the plant is South America but it can be grown in West Indies, India, Ceylon, Java and elsewhere. The composition of the leaves is very inconstant and varies with different specimen of leaves. Cocaine, the most important alkaloid, occurs to the extent of about 0.15 to 0.8 per cent. in the leaves associated with many other alkaloidal substances, cinnamyl cocaine, α-truxilline, β-truxilline, benzoyl-ecgonine, tropacocaine, hygrine, cuscohygrine, etc. These substances may be collectively termed 'cocaines' and are all derivatives of ecgonine.

After the discovery of its value as an anæsthetic, the demand for coca leaf in Europe rapidly increased and efforts were made to start plantations on a large scale. The alkaloid cocaine is largely used by the medical profession in India. A glance at the table of imported drugs and medicines will show how the quantity of imported cocaine is gradually increasing. In the year 1928-29, 1,259 ounces of cocaine were imported into India.

E. coca has, however, never been cultivated in this country on a large scale. Some years ago (1926) it was suggested in the English daily press in India that cocaine-bearing *Erythroxylon coca* was growing wild all over the country, that the people were learning the habit of chewing the coca leaf, and that there might be secret factories for manufacture of cocaine. In support of this theory, it was argued that large quantities of the drug were seized on railways and the cocaine

habit was spreading rapidly and no one had been able to trace the source from which the drug was obtained. The alleged cultivation of coca plant was also referred to at a meeting of the Advisory Committee of the League of Nations on traffic in opium and other dangerous drugs in 1925. Careful inquiries were then made by the Government of India and recently we have been able to fully corroborate the views then expressed by the authorities. Neither *Erythroxylon coca* nor any other plant from which cocaine can be produced is cultivated in India, except that *E. coca* is sometimes grown as an ornamental plant in the gardens in Bombay and there are specimens at the Royal Botanical Gardens, Calcutta, and in the Botanical Gardens at Madras and Kallar (in the Madras Presidency). So *E. coca*, far from growing wild all over the country, is not known to grow wild anywhere in India. A few plants were found in some of the Nilgiri estates, which were in all probability the relics of the experiment made in 1885, but even these contained little or no cocaine. The manufacture of cocaine is a highly technical process and there is no ground whatever for the belief that cocaine is secretly manufactured in India and, as will be shown in subsequent pages, there is no mystery whatsoever about the source of the illicit cocaine seized in India. It is undoubtedly all manufactured in certain countries outside India.

Use of E. coca for Euphoric Purposes:—The use of coca leaf for euphoric purposes, however, started many centuries ago in South America; the natives of Peru and Bolivia were known to indulge in the leaves of *Erythroxylon coca* as early as the 15th century. They were in the habit of chewing leaves during the times of great physical strain such as long laborious marches in the hills, as by so doing they felt refreshed and invigorated. The leaf was generally taken mixed with lime or ash of some plant. The powdered leaves were kept in flask-shaped pumpkin shells and were taken off in small quantities with a needle, the end of which was moistened in the mouth. There were a number of other preparations also made from the leaf which were used by the populace. The planters and miners of the land encouraged its use because they

could get greater amount of work out of the labourers under its influence.

Although the alkaloid cocaine was discovered in 1859-60, the importance of the plant from the medicinal point of view grew more from 1884 and the export of dry leaves from South America started from that time. In order to reduce the cost of transport, factories were started in Peru about 1890 which manufactured crude cocaine for export to other parts of the world. During the year 1890, 1730 kilograms of the crude alkaloid were exported and this increased to 10,600 kilograms in 1901. It was in this way that the alkaloid replaced the leaves and the knowledge of the effects produced by it spread to other parts of the world. Between 1890 and 1900 cocaine began to be fairly largely used in the United States for euphoric purposes and the habit was also getting known to Europe, India and China. It was thought at that time that the administration of cocaine cured the morphia habit and alcoholism and this gave a stimulus to its use by the medical profession in the treatment of these conditions. Unfortunately, instead of curing morphinism it produced among many patients morphino-cocainism.

The successful use of the drug for producing local anæsthesia began to be appreciated more and more by medical men, and this increased the demand for the alkaloid to such an extent that it was considered worth while to prepare it by synthetic methods. The preparation of the alkaloid, however, is easier and cheaper from the leaf, and large plantations were started in Java and other places. The world thus became independent of South America, and the alkaloid became comparatively cheap in price The leaf from Java goes to factories in Europe, America and Japan, and the South American product has been practically driven out of the market. In 1922, 1.7 million kilograms with a cocaine content of 1.2 to 1.5 per cent. were exported from that island.

Cocaine Habit in India :—As early as the nineties of the last century it was realised that cocaine was being used in certain parts of the province of Bengal and Bihar for its euphoric effects. The earliest record of its use came from a small town named Bhagalpur. The story is related of a big land owner of that place who contracted the habit accidentally after its use to relieve dental pain. So extraordinary were the effects produced on him that not only did he become habituated to its daily use but passed on the habit to many others. It was stated at that time that cocaine was secretly sold to a considerable extent to school boys and students, merchants and men of good class in the community. The price of the alkaloid at that time was Rs. 3 per drachm or about one anna per grain, and it was usually sold to the public in packets of ½ grain each. The evil effects pro-

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duced by the drug were not fully appreciated at that time by the profession and the laity, and therefore, no restrictions were imposed on the sale and use of this dangerous drug.

The habit, however, spread so quickly from Bhagalpur to Calcutta and other large towns and the ravages produced by it in the addicts became so evident in a short time that it soon came to the notice of the medical profession and the authorities. Steps were at once taken by the Excise Department to restrict its import and sale. In the meantime, the evil had unfortunately taken root and many large towns had become affected. The habit had spread along the two main routes even to Northern India. It worked its way up through Benares, Lucknow, Rampur, Saharanpur and Ambala on the one side, and through Allahabad, Cawnpore, Agra, Muttra and Delhi on the other side. We are credibly informed that in Delhi the addiction existed on a fairly extensive scale in the year 1900. In this town it is reputed to have spread through the agency of a medical practitioner who prescribed it as a stimulant and as a tonic. In Saharanpur the habit was fairly common 20 to 25 years ago, and there a trained midwife is said to have been responsible for its introduction. Tracing its progress further north there is no doubt that the spread of the habit to the town of Amritsar in the Punjab was through shawl merchants, who were in constant communication with Calcutta. From Amritsar the addiction spread to Lahore. Peshawar was also involved early owing to large number of inhabitants of this town being constantly on visits to Calcutta in connection with the fruit trade. A very able Excise officer of the North-West Frontier Province assured the author that Peshawaris were in a great measure responsible for trafficking in cocaine carried on in India. Large quantities of Charas (resin of *Cannabis sativa* manufactured in Central Asia) were smuggled through the North-West Frontier Province and sold at a very cheap price along the frontier. These were carried by them to such big centres as Bombay and Calcutta and were sold at very large profits. The proceeds of this sale were employed to smuggle cocaine back from the sea-port towns to different parts of India, particularly large towns of Northern India.

After the isolation of the alkaloid, the chief method of taking the drug in the western countries was by hypodermic injection, and owing to difficulties of administration the habit did not spread to any great extent at that time. Soon, however, the easy method was discovered of taking it in the form of snuff and by rubbing it on the gums. This was quickly followed by spread of the habit to large centres of Negro population in the United States.

The most common method of taking cocaine in India is by putting it in 'pan' or betel leaf. That is the reason why addiction to the drug is more prevalent amongst people who indulge in 'pan' chewing. As is well-known the betel leaf is taken by mixing it with small quantities of catechu and slaked lime, a little betel-nut or sometimes spices, such as cinnamon, cardamom, ginger, etc., are also added. The drug is either mixed with the spices and then wrapped in the betel leaf or some of the addicts place the alkaloid on the dorsum of the tongue and then chew a 'pan' immediately afterwards. Addicts who have been indulging in the drug for a long time generally put the cocaine on the tongue and merely take a little lime and catechu afterwards dispensing with the betel leaf. It is said that by doing this the action of the drug is enhanced and the effects produced are stronger. Rarely the drug has been taken in the form of a solution, obtained on a doctor's prescription, the addict sipping the solution at intervals following it each time with a betel leaf. The method of rubbing the drug into the gums or taking it as a snuff is up to the present time unknown in this country. A rare method which is sometimes used, particularly by the prostitutes, is that of injecting a solution of cocaine into the vagina by means of a douche can. This gives the individual a sense of local constriction and the general systemic effects appear almost immediately. The sexual act is said to be prolonged if the drug is administered in this way.

The Present Extent of Cocaine Habit in India:—It is not possible to say with any degree of accuracy the present extent of cocaine habit in India. Tuke (1914) said that the habit of taking cocaine was by no means confined to the poor and uneducated classes. From the information we have gathered from our work in the field in various provinces of India, it transpires that only members of the medical profession at first knew about the euphoric properties of cocaine, and that it was from them that the lay people learnt about its effects. As in early days there were no restrictions regarding the possession and sale of the alkaloid, the habit quickly spread from one commercial city to another on account of the more rapid

methods of transport which were coming into vogue owing to the extension of the railway system in the earlier part of this century. The stimulant effects produced by the drug were a great attraction to a type of individual, who was ignorant of its evil effects on the system. Moreover, the enormous financial gain which the dealers in this nefarious traffic obtained, soon induced them to employ agents to push on their trade and to advocate and popularize its use. It thus came about that, even when restrictions were imposed, the use of the drug was not curtailed but rather spread, so much so that cocaine to-day is a well-known commodity to many of the inhabitants of large towns in India. It is popularly believed to be a sexual stimulant, and many start it for this purpose. The other attraction for its use is that it has a most extraordinary effect, temporary though it be, in rapidly overcoming mental as well as physical fatigue. As we have already stated, its use rapidly spread from Calcutta to large towns along the two main railway routes through the United Provinces, into the Punjab and to the North-Western Frontier Province and even to the tribal territory on the North-West Frontier of India. The drug was also smuggled into Bombay and on that side its use spread to different large cities of the Bombay Presidency (*e.g.*, Ahmedabad), Central India and the Central Provinces. We have been impressed by the fact that it was the large towns along the main railway lines from Calcutta and Bombay which were affected. Large cities along the branch lines remained free from this addiction or were only affected in exceptional cases. The only part of India where the habit seems not to be known to any extent is the Madras Presidency.

Cocaine Traffic and Modes of Smuggling :—For medicinal purposes cocaine was imported into India from European countries particularly from Germany and supplies were also obtained from America. When restrictions were brought into force regarding its sale and use, a certain amount of the alkaloid began to be illicitly imported from the same sources. For some time past the Far East has driven the European and American manufactured article out of the Indian market, Japan being the chief source now. She manufactures and supplies India and Amoy in China. The drug is brought from Japan to Calcutta by steamers of the various lines of mercantile marine. The

conveyors are mainly the Chinamen on board. Many of these steamers have Chinese crews and some have both Indians and Chinese on board. Indians and Chinese are both engaged in smuggling but work independently of one another. The Indian share is believed to be much less than that of the Chinese. Imports are managed through personal conveyers among the crew, not jointly by concealment in merchandise. Supplies in Rangoon are received from Amoy by Chinese-owned lines of steamers plying between Amoy and Rangoon. China itself manufactures no cocaine but imports it from Japan and Europe. A capture made in Burma in 1928 included some items bearing the name of a reputed firm in Germany, that were traced to a consignment sent to a Chinese firm of chemists at Amoy. Most of the cocaine which is being received bears labels which are entirely fictitious. The commonest met with is that of 'Fujitsuru brand', showing a stork in flight with a mountain in the back ground. From the information which it has been possible to gather in this country it appears that this brand is packed and labelled and received by the Calcutta-bound carriers in Japan, but that a copy of the label of this brand is made use of by dealers in Amoy who put up an adulterated product for despatch from there to Rangoon. Other fictitious brands found are the Elephant, Buddha, K.S., and Tacunufa. As there is no line of steamers that comes direct to India from Japan without calling at a Chinese port, it cannot be proved absolutely that the source is in Japan and not in China. Japan, however, is known to have factories but China has none. On the other hand China may get its supply from Europe. Side by side with these fictitious brands, cocaine is also found bearing the labels of genuine Japanese factories namely the Hoshi, Koto Seiyaku, Takeda and Sankyo firms; and it is an interesting fact that cocaine found with Japanese smugglers in this country—for there are Japanese engaged in the Indian import traffic too—bear either these genuine labels or none at all, any way not those of the Fujitsuru, Elephant, etc. As far as can be ascertained, Amoy supplies Burma and no other place, Calcutta supplies come from Japan, either direct or transhipped at Hongkong or Singapore. The drug is brought in hidden and in some cases even the officers of the ship have been implicated; it is stowed away in all sorts of inaccessible places in the boats. On account of its small bulk the landing of the drug does not appear to present much difficulty to those engaged in the traffic. It is often not brought into the port at all and is thrown overboard in water-tight packets into the sea or into the river from where it is picked up by a well-organized gang of smugglers. In this way large quantities of the drug find their way into towns like Calcutta into the hands of large dealers.

The amount seized by the Calcutta Customs alone last year was 7,200 ounces and experienced officers place the seizures

between 2 to 5 per cent. of the quantity actually got through; this means that somewhere 200,000 to 250,000 ounces of cocaine were successfully smuggled into the country. It has been calculated by competent authorities that consumers in India must have paid between Rs. 270 lacs and Rs. 648 lacs to the retailers for their doses during 1929. This is an enormous sum of money. One can also form some idea of the total number of persons habituated to the drug from the above. Taking an average dose as 2 to 3 grains daily there must be somewhere between a quarter and half a million individuals taking cocaine in India for its euphoric effects. This figure is very much on the low side as a large amount of cocaine smuggled is heavily adulterated by the dealers in this country.

Effects of Cocaine Habit:—The disorders and effects produced by the habitual use of coca leaves, which are chewed, and the alkaloid cocaine are not the same. The differences are similar to those of opium and morphine. In fresh coca leaves there is a fragrant resin and other alkaloids, *e.g.*, dextro-cocaine, etc.

It is remarkable that as opposed to morphine, animals are said not to become accustomed to cocaine though a case has been recorded of a monkey who became a cocaine eater through imitation. The action of cocaine on the brain is very powerful; a single injection may cause serious troubles of the functions of the brain, *e.g.*, mental disorders, illusions, melancholia which appear after one day and frequently last for weeks and months. The prolonged abuse brings about gradual development of graver symptoms. A cachectic state appears with extreme emaciation, gradual change of demeanour, apathy, hallucination and a passionate desire for the drug. Will-power diminishes and indecision, a lack of sense of duty, capricious temper, obstinacy, forgetfulness, diffuseness in writing and speech, physical and intellectual instability set in. Conscientiousness is replaced by negligence, truthful people become liars and criminals and lovers of society seek solitude. The destructive action on the cerebral functions becomes apparent. Mental weakness, irritability, erroneous conclusions, suspicion, bitterness towards his environment, a false interpretation of

things, insomnia, hallucination, abnormal sensations under the skin commonly occur. The unfortunate being leads a miserable life where hours are measured by the imperative necessity for a new dose of the drug. He becomes a physical, mental and moral wreck.

References :—

(1) Chopra, R. N., and Chopra, G. S., 1931, *Indian Jour. Med. Res.*, Vol. XVIII, p. 1; (2) Lewin, L., 1931, *Phantastica*.

EUCALYPTUS GLOBULUS (N.O. Myrtaceæ)

Blue Gum-tree

VERN.—Tam.—*Karpura maram*

There are more than 300 species of the genus Eucalyptus, most of which are valued for their timber. Only about 25 species yield the eucalyptus oils of commerce, chief amongst which are *E. globulus* and *E. dumosa*. Australia may be said to be the home of Eucalyptus in as much as it forms about 75 per cent. of the vegetation of that continent. Eucalyptus oil is distilled from the fresh leaves and terminal branches of the trees. It is very important commercially. Large quantities of the oil are employed in scenting soaps and also in separating mineral sulphides from their ores. Experiments on the use of the oil as a motor fuel are in progress. The oil is employed in medicine and pharmacy to a large extent and its powerful antiseptic and disinfectant properties are well-known. The constituents of eucalyptus oil have been thoroughly worked out. They may be classified as follows:—

1. Oxide	*e.g.* cineole (eucalyptol)
2. Alcohols	,, geraniol, eudesmol, methyl alcohol, terpineol, etc.
3. Aldehydes	,, butaldehyde, valeraldehyde, cryptal, citral, citronellal, etc.
4. Ketone	,, piperitone
5. Phenols	,, tasmanol, australol
6. Esters	,, geranyl acetate, butyl butyrate, etc.
7. Terpenes	,, phellandrene, limonene, etc.

8.	Sesquiterpene	*e.g.* aromadendrene
9.	Benzene hydrocarbon	,, cymene
10.	Solid ,,	,, paraffin
11.	Free acids	,, acetic acid, formic acid

Of these, cineole (eucalyptol) is the most important ingredient from the medical point of view. Australol and cryptol have also been found to be efficient antiseptics with a carbolic acid co-efficient of 13 and 12.5 respectively, but these are seldom used as such. The British Pharmacopœia prescribes that medicinal samples of eucalyptus should contain not less than 55 per cent. of cineole, while the U. S. Pharmacopœia requires the cineole content to be 70 per cent.

Eucalyptus trees are not natives of India but many species are grown in different parts of the country, notably in the Nilgiris. The tree is very valuable on account of the products it yields. The essential oils, dyes, perfumes and kinos are all very useful and attempts have been made during the last fifty to sixty years to cultivate them in many parts of the globe, *e.g.*, California, Spain, South Africa, Algeria, East Africa, Mauritius, Java and Malaya. These attempts have mostly met with success. It is, however, necessary to find by experiment which species are most suitable to the particular country. Much depends on this selection. In Malaya, *E. rostrata* and *E. citriodora* flourish whereas *E. globulus* is found to be unsuitable. In India, plantations of *Eucalyptus globulus* have been reared in the Nilgiris to the extent of 2,000 acres producing 5 tons of leaves per acre. The seedlings are raised in beds made up of fine prepared loamy soil with some quantity of wood ashes mixed. Watering is necessary till germination to ensure good growth of the trees. Distillation of the oil was started in this country about 30 years ago and it is estimated that about 24,000 lbs. of oil are produced annually. The oil obtained from the leaves growing in the Nilgiris plantations was studied by Puran Singh. It contains pinene, cineole, sesquiterpene and free alcohols in small amounts, but unlike the Australian oil neither eudesmol nor aldehydes; phellandrene is likewise absent. The constants of the oil have also been determined:—Specific gravity, 0.9065 to 0.9155;

optical rotation, +5° to +10° ; refractive index, 1.463 to 1.466 ; saponification value, 8.9 to 20 ; cineole, 60 per cent.

The oil is practically insoluble in 70 per cent. but dissolves in less than 1 volume of 80 per cent. alcohol. The British Pharmacopœia (1914) has adopted the following standard:—Specific gravity, 0.910 to 0.930 ; optical rotation, −10 to +10° ; solubility in 70 per cent. alcohol, 1 in 5 ; cineole, 55 per cent. by volume.

A comparison of the properties of the Indian oil with the B. P. standards will convince anyone that the Indian oil satisfies very closely the pharmacopœial requirements and may be used without hesitation for medicinal purposes. In fact the quantity of oil which is produced from the Nilgiri plantations is sold to the Government Medical Stores, Madras, and the authorities have never had any reason to find fault with it. Unfortunately all the species of eucalyptus growing in India have not proved to be equally valuable as the *E. globulus* type described above. Two species of eucalyptus growing in Dehra Dun have been examined by Ghosh (1919). The yield of the oil from *E. tereticornis* was about 0.66 per cent. from the fresh leaves and was free from phellandrene. The amount of cineole was found to be very low, only 10.4 per cent. The oil from *E. crebra* on the other hand, proved to be absolutely free from either cineole or phellandrene. These oils could not be used for medicinal purposes owing to the subnormal quantity or absence of cineole. It is, therefore, important to cultivate the proper species, and if this is done there is every chance of the enterprise becoming a success. It does not, however, seem likely that the Indian eucalyptus products will be able to compete with those from the Australian eucalyptus in commerce. The soil and climatic conditions of Australia are especially suitable and the Australian Commonwealth has never been slow to appreciate the value of the product and to exploit their resources to the best advantage. The enormous quantity of oil exported from that country will bear testimony to this statement. In spite of successful attempts to grow the tree in other countries, Australia still maintains her lead in the supply of this oil.

Export of Eucalyptus Oil from Australia

1921-22	...	...	35,039	gallons	£24,470
1922-23	...	...	53,129	,,	£34,602
1923-24	...	...	79,557	,,	£65,858
1927-28	...	...	107,876	,,	£90,929
1928-29	...	...	114,094	,,	£85,009

In the field of medicine, the Indian oil should have better prospects. Phellandrene, which is present in the Australian oil to a fairly large extent, is very irritant to the bronchial mucosa, especially if inhaled and has been considered to be powerfully depressant to the heart. The British Pharmacopœia tests expressly exclude oils containing much of this principle. The butyric and valerianic aldehydes also are obnoxious constituents in the Australian oil. Both these constituents are absent from the Indian oil and therefore this should merit better consideration by physicians as this oil is less likely to produce coughing and other unpleasant side-effects.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Macpherson, J., 1925, *Medical Journal of Australia,* July; (3) Puran Singh, 1917, *Indian Forest Records;* (4) Ghose, 1919, *Perfumery and Essential Oil Records,* Schimmel & Co.

EUONYMUS TINGENS (N.O. Celastrineæ)

Dogwood ; Spindlewood ; Prickwood.

VERN.—Hind.—*Bárphali, Sikhi, Kungku, Pápar, Késari ;* Nepal—*Newar, Kasuri ;* Simla—*Chopra, Mer mahaul.*

The genus Euonymus consists of about forty species, most of which are scattered over the tropical regions of Asia, the Malay Archipelago, Europe and America. This drug has been used in medicine for a very long time and is said to be mentioned in Pliny's book. Its purgative properties are not very pronounced but it is supposed to stimulate the liver, and this leads to increased secretion of the bile. In combination with cascara, and iridin, etc., it is prescribed by practitioners in cases of torpid liver with flatulence and indigestion. The Euonymus that is available in the Indian markets is mostly *Euonymus atropurpureus* (*E. hamiltonianus*) exported from the United

States. In the temperate and Western Himalayas, Euonymus trees are to be found growing in abundance. *E. tingens, E. crenulatus* and *E. pendulus* are the species usually met with; these do not appear to have been used as purgatives in Western medicine or in the indigenous systems. The reason is difficult to understand. The bark of *E. atropurpureus* contains several bodies like euonymol, atropurol, euonysterol, mono-euonysterol which are responsible for its activity. The Indian variety of euonymus contains almost the same active principles. The tincture made from Indian euonymus bark though not so bitter as that from the foreign variety, possesses almost identical medicinal properties.

References :—

Rogerson, H., 1912, *J. C. S., Trans.*, p. 1040.

FERULA FŒTIDA (N.O. Umbelliferæ)

Asafœtida

VERN.—Sans.—*Hingu* ; Hind. & Beng.—*Hingra, Hing* ; Bomb.—*Hingra* ; Tam.—*Káyam, Perungayam* ; Tel.—*Inguva* ; Pers.—*Anguza* ; Afg.—*Anguza, Kurne, Khora.*

The gum-resin obtained by incision from the roots of *Ferula fœtida* and some other umbelliferous plants which grow wild in the sandy deserts and dry arid hills of eastern Persia, Khorasan, Kandahar and Afghanistan is known as asafœtida. Several varieties are recognised, *e.g., Ferula alliacea* ('hing' or 'moltani hing' of the Indian), *Ferula fœtida* ('hingra' or 'Kandahari hing') and *Ferula galbaniflua* ('Gandhaburoja'). They all appear to possess very similar properties, though differing slightly in physical characters and appearance. *F. fœtida* has been extensively used in India and has been held in great esteem in the indigenous medicine from the earliest times. It is reputed as a carminative and antispasmodic and is extensively used in hysteria and nervous disorders of women and children. It is used as a flavouring agent and forms a constituent of many spice mixtures used all over India. It is

chiefly for this reason that large quantities of this aromatic gum are imported. It has been estimated that on an average about 6,000 cwts. valued at Rs. 2,16,300 are brought in annually by Afghan merchants and sold to the frontier towns, who distribute it all over the plains of India. Undoubtedly some is exported but this is an insignificant amount (about 1 per cent. of the total import) and the major portion of the imported drug remains in India.

Ferula narthex grows abundantly in the valleys of Kashmir and gives a fairly good yield of this gum-resin which could form a good substitute for the imported commodity. The possibility of substitution was early appreciated by the Drugs Manufacture Committee and a quantity of the gum-resin was actually sent for analysis early in 1922. But owing to decomposition in the course of transport, definite findings were not obtainable. No further attempt has been made to collect this gum-resin and to study its properties with reference to the possibilities existing. In the areas where *F. narthex* is found growing, local people use it commonly as a substitute. Further work is necessary to improve the industry.

References :—

(1) Dutt, 1928, *Commercial Drugs of India;* (2) Humphreys, 1912, *Drugs in Commerce;* (3) *Sea-borne Trade Statistics of British India*, 1928-29.

FŒNICULUM VULGARE (N.O. Umbelliferæ)

The Fennel

VERN.—Sans.—*Madhurika ;* Hind.—*Bari saunf, Sonp, Sont ;* Beng.—*Pan-mouri, Mauri ;* Bomb.—*Bari-sopha ; Tam.—Sohikire, Shombu ;* Tel.—*Sopu, Pedda-jila-kurra.*

The fennel is a perennial herb commonly cultivated throughout India mostly on homestead lands. It can, however, be grown as a cold weather crop at all altitudes up to 6,000 feet. It is also found growing wild in various localities. It flourishes in open sites in alluvial soil devoid of excess of moisture. Several species grow in India, but these are essentially similar to the varieties growing in other countries, *e.g.*, Galicia,

Germany, Russia, Roumania, Macedonia, Egypt, Asia Minor, Persia and Japan. The only difference is in the seeds which are smaller and straighter than in the European fennel.

Fennel fruit contains a volatile oil with a pleasant aromatic odour. The chief constituent is anethole, but small quantities of other substances like fenchone are also present in certain varieties. It is used in Europe in the manufacture of cordials and enters into the composition of fennel-water which is employed medicinally, mostly as a vehicle for other drugs and as a flavouring agent. Though not much used in the pharmacopœial preparations, fennel fruits are in great demand in the indigenous medicine in India. It is considered as a stimulant, carminative and aromatic. A hot infusion is not infrequently used to increase the lacteal secretion and to produce free sweating. It is doubtful how far the claims of the indigenous medicine could be substantiated, but the fruits have a great commercial importance. In France particularly, fennel is cultivated on a fairly large scale. This may be estimated from the fact that the Department of Gard in France cultivates 300 hectares producing annually about 300,000 kilos of oil. Large quantities of the fruits are employed in that country in the liquor industry, as much as 2,000,000 kilos on an average having been imported annually into France *via* Marseilles. India exports nearly 500,000 kilos of fruits per year, but with the potential resources existing in India a distinct advance could be made towards capturing the markets of France by supplies of fruit and oil from this country. In view of the fact that the Indian oil compares favourably with that obtained from other countries, there is every prospect of success. An examination of the properties of the different oils will make this clear.

	French Oil	Galician Oil	Russian Oil	Indian Oil
Specific gravity at 15°C. ...	0.976	0.966	0.967	0.968
Optical rotation in 100 mm. tube	+16.0°	+22°	+23°	+21°
Melting point after solidification	12.5°.	4.0°	4.4°	8.2°
Percentage of fenchone	...	19.3	18.2	6.7

The yield of oil obtained is very variable, according to the fruit distilled. In general it averages from 4 to 6 per cent. The yield of the Indian oil was stated to be about 3 per cent. Recently, Rao, Sudborough and Watson studied the oil obtained from *Fœniculum panmorium* and have found the yield to be 0.72 per cent. on an average. This yield is rather low in comparison to the other varieties as will be seen from the table below:—

Fennel Fruits

	Variety		Percentage of oil
1.	French sweet	...	.. 2.1
2.	German (Saxon)	..	... 4.7
3.	Indian	..	0.72
4.	Russian	...	... 4.8
5.	Galician	...	... 4.4
6.	Japanese	...	... 2.7

From the point of view of commercial exploitation, this low yield might be prejudicial to the growers. Pure anethole has also been placed on the market so that the importance of the oil has to a great extent gone into the background. Further investigations should be carried out to determine whether by proper and scientific cultivation this yield can be increased or not.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Rao, Sudborough & Watson, 1925, *Jour. Ind. Inst. Sci.*, p. 184; (3) Umney, J. C., 1897, *Pharm. Jour.*, vol. 4, p. 225.

GAULTHERIA FRAGRANTISSIMA (N.O. Ericaceæ)

Indian Wintergreen

VERN.—Jav.—*Gandapuro.*

Oil of gaultheria (oil of wintergreen) is largely used in medicine as an external application for rheumatic affections, sciatica, neuralgia, etc. It is a very popular remedy and seldom will a prescription for aches and pains be met with where the physician does not use this drug. In almost all the proprietary balms, liniments or ointments, oil of wintergreen or its chief constituent methyl-salicylate occurs to a greater or lesser extent. Apart from its use in medicine, it is also used as a flavouring agent in tooth pastes, etc.

Oil of wintergreen is obtained by distilling the leaves and sometimes the whole herb of *Gaultheria procumbens*, a plant indigenous to the United States of America. A similar oil is distilled from the wood and bark of *Betula lenta* (the sweet birch) which grows profusely in the mountains of the Carolinas, Tennessee, Kentucky and Pennsylvania and this is now largely sold as wintergreen oil. The chief constituent of both these oils is methyl-salicylate, but the sweet birch oils differ slightly in composition from the true wintergreen oil. The composition of the two oils, according to Power and Kleber is as follows:—

Oil of Gaultheria	Oil of Sweet birch
Methyl-salicylate 99.0 per cent.	Methyl-salicylate 99.8 per cent.
Paraffin	Paraffin
An aldehyde or ketone	An aldehyde or ketone
Ester	Ester
A secondary alcohol	Optically inactive
Optically active	

The British Pharmacopœia allows the use of both oils under the name of 'Oil of Gaultheria' while the United States Pharmacopœia, recognising that these oils are composed chiefly of methyl-salicylate has made methyl-salicylate official. But all the three articles namely synthetic methyl-salicylate, oil of gaultheria and sweet birch oil are allowed by the authorities provided the label states which source has been employed. Methyl-salicylate has further been discovered in many plants of the natural orders, *Betulaceæ, Rosaceæ, Polygalaceæ, Ericaceæ, Leguminosæ*, etc., growing in different parts of the world, but the active principle in some of them is present in too small quantities to be of any commercial value.

Gaultheria fragrantissima, Wall., grows freely in the Nilgiris, in Travancore, near Toungoo in Burma and particularly in Assam. Puran Singh (1917) studied its distillation products with a view to its commercial exploitation. He found that only the Assam herb contains sufficient oil for commercial purposes. The results of his experiments were as follows:—

		Fresh herb	Dry herb
(1) Nilgiris Gaultheria ...	350 lbs.	0.036 per cent.	0.067 per cent.
(2) ,, ,, ...	500 ,,	0.120 ,, ,,	0.23 ,, ,,
(3) Assam ,, ...	350 ,,	0.65 ,, ,,	1.2 ,, ,,

The properties of the Indian wintergreen oil have also been found to be very similar to those obtained from other countries. The constants of the Assam oil are as follows:—Specific gravity 1.185; optically inactive; soluble in 6 parts of 70 per cent. alcohol; methyl-salicylate content 99.1 per cent.

Economic Aspects:—It will be seen that methyl-salicylate constitutes from 95 to 99 per cent. of oil of wintergreen and oil of sweet birch. Oil of wintergreen was formerly used largely for the manufacture of 'natural' salicylic acid. The situation has changed considerably since the production of synthetic methyl-salicylate from coal tar. For some time the natural product was still preferred on account of the presence of certain objectionable impurities in the synthetic methyl-salicylate. The manufacture of the latter has now reached such a state of perfection that the natural product from wintergreen possesses no advantage. The price of the synthetic product is also much cheaper than the natural product. Furthermore, oil of gaultheria, according to the British Pharmaceutical Codex, may give rise to an eruption at the site of application much more frequently than the synthetic product. It is not surprising, therefore, that the synthetic product has largely supplanted the natural in general use.

Though the outlook of the commercial utilisation of the natural product from *Gaultheria fragrantissima* of India does not seem very bright, there is no reason why the existing resources should be allowed to go waste and why proper investigation should not be taken up. According to Puran Singh (1917) the yield of the oil from the Indian plant is rather low, but by improved methods of distillation the yield of the oil could probably be increased. Experiments carried out recently in Germany by Ziegelmann show that by macerating the material some time before distillation a better yield is obtained. This will be evident from the following table:—

Yield of Oil per cent. (Sweet birch bark)	Yield of Oil per cent. (Gaultheria leaves)
0.20 (no maceration)	0.70
0.41 (12 hours at 40°C)	1.30

It is probable, therefore, that if improved methods of extraction are followed as in Germany, gaultheria oil production in India may be a profitable proposition. With cultivation to ensure regular supplies, the oil could be produced in Assam at Re. 1-10 as compared to Rs. 4/- per pound for the pre-War synthetic methyl-salicylate. Though the price of the synthetic product has come down considerably since the War (Rs. 2-8 per pound) still there is handsome margin of profit left for the producers. India can at least supply her own needs of oil of wintergreen from the resources existing in her own soil.

References :—

(1) Finnemore, 1926, *The Essential Oils*; (2) Schimmel & Co., 1895, *Report*; (3) Puran Singh, 1917, *Indian Forest Records*.

GENTIANA KURROO (N.O. Gentianaceæ)

Gentian

VERN.—Beng. & Hind.—*Karu, Kutki* ; Bomb.—*Phashanveda* ; Guj.—*Pakhan-bhed* ; Punj.—*Nilkant, Kamalphul.*

PICRORHIZA KURROOA (N.O. Scrophularineæ)

VERN.—Sans.—*Katuka, Katurohini* ; Hind. & Beng.—*Katki, Kuru* ; Punj.—*Kali kutki* ; Bomb.—*Balkadu* ; Tam.—*Katuku-rogani* ; Arab. & Pers.—*Kharbaqe-hindi.*

Gentian has been known as a medicine from antiquity, and many of the complex preparations handed down from the ancient Greek and Arabian physicians include it among their ingredients. It is one of the most important bitters in the Pharmacopœia and is very extensively used. It possesses in a high degree the tonic properties which characterise all the simple bitters. On account of its aromatic properties it is agreeable to take and because of the absence of tannin it has no astringent action. It is, therefore, preferred to many other bitters and enters into most of the stomachic and tonic prescriptions of modern practice. The official source of the drug is the rhizome and roots of *Gentiana lutea* (the common

European yellow gentian)—a handsome perennial herb growing in the Alpine and Sub-Alpine regions of central and southern Europe. The dried roots in cylindrical pieces, entire or longitudinally split, are imported extensively into India. Several species of Gentian, *e.g., G. kurroo, G. decumbens, G. tenella,* etc., are met with in the mountainous regions of India, but these are not utilised to any extent in medical practice, though all the varieties are to a greater or less extent characterised by the bitterness of their stems and roots. *Gentiana kurroo* appears to be the best known and most widely employed species as a substitute for the official drug. This is a small herb with a handsome blue flower common in Kashmir and North-West Himalayas at an altitude of 5,000 to 11,000 ft. It grows on bare hill sides as well as on the ledges of rocks. It is largely exported from the hills to the plains but on account of the fact that no detailed chemical study of the composition has been done so far, medical men and manufacturers of pharmaceutical products cannot make use of them. Recently, however, a sample of the roots of this species received from the Divisional Forest Officer, Utilization Division, Kashmir, was analysed at the Forest Research Institute with the following results:—

	Gentiana kurroo	*Gentiana lutea* (B. P. Standard)
Aqueous extract ...	20 per cent.	30—40 per cent.
Ash ...	... 0.70 per cent.	Not more than 6 per cent.
Gentiopicrin	... Nil	1.5 per cent.

It will appear from the above, that this variety of Gentian does not contain gentiopicrin, which is considered to be the active principle of *Gentiana lutea.* From the scientific standpoint, therefore, the *Gentiana kurroo* roots cannot be used as a substitute for the official drug. According to the British Pharmaceutical Codex, however, the process of drying of the gentian roots may have a marked effect on their ultimate composition. Gentiopicrin, the active principle, is present in fresh *Gentiana lutea* roots and if these are allowed to undergo slow drying, Gentiopicrin is likely to be hydrolysed, to a

greater or less extent, by fermentative changes with consequent diminution of water-soluble substances. It is, therefore, possible that the absence of gentiopicrin and the lack of aqueous extractives in the *Gentiana kurroo* roots, is due to the process of drying adopted in Kashmir before the samples were sent to the Dehra Dun Institute for analysis. In view of the cheap price and easy availability of *Gentiana kurroo* roots the possibility of substitution of this variety in place of the imported *Gentiana lutea* should further be explored.

It will be useful, in this connection, to discuss *Picrorhiza kurrooa*, as this is very commonly used either as an adulterant of or as a substitute for *Gentiana kurroo*. Great confusion exists with regard to the identity of these drugs as the name *katki* is employed in the vernacular to mean both of them. *P. kurrooa* is considered in the indigenous medicine to be a valuable bitter tonic almost as efficacious as gentian. Further, it has the reputation of being an antiperiodic and cholagogue. It is a low hairy herb found in North-West Himalayas from Kashmir to Sikkim. It appears to be fairly extensively used in those localities by the people and there is also evidence to show that a fairly large quantity is collected and sent down regularly to the plains. A systematic chemical investigation of the roots was undertaken with a view to determine the active principles responsible for its action. On extraction with different solvents the following results were obtained :—

Petroleum ether extract	...	...	1.49 per cent.
Sulphuric ether extract	...	...	3.45 ,, ,,
Absolute alcoholic extract	...	...	32.42 ,, ,,
Aqueous extract	...	...	8.46 ,, ,,

On further examination of different extracts, it was found that—(*a*) Petroleum ether extract contains a trace of an alkaloid and a waxy substance melting at 39°C. (*b*) Sulphuric ether extract contains a glucoside, tannins and organic acids. (*c*) Alcoholic extract contains a glucoside, resins, etc. (*d*) Aqueous extract contains sugar, large quantities of bitter substance, etc.

The percentage of the bitter substance in the drug was found to be 26.6 per cent. A glucoside was obtained as a cream coloured amorphous powder, extremely bitter and hygroscopic having a specific

rotation of $-100°$ (in aqueous solution). It is freely soluble in water, acetone, alcohol and acetic ether, insoluble in chloroform, benzene, ether, etc.

From the above it will appear that Picrorhiza contains a fairly large percentage of bitter substance. As the pharmacological activity of gentian depends on the bitter principle contained in it, *Picrorhiza kurrooa* if properly standardised, might be used on a more extensive scale in cases where bitters are indicated.

References :—

(1) Dutt, 1928, *Commercial Drugs of India;* (2) *British Pharmaceutical Codex,* 1926.

GLYCYRRHIZA GLABRA (N.O. Leguminosæ)

Liquorice

VERN.—Sans.—*Yashti-madhu* ; Hind.—*Jethi-madh* ; Beng.—*Jashti-madhu* ; Bomb.—*Jashtimadhu* ; Tam.—*Atimaduram*.

Glycyrrhiza glabra or liquorice has been known in pharmacy for thousands of years. In old Chinese pharmacy, it was considered to belong to drugs of the first class and to it was ascribed the property of rejuvenating those who consume it for long periods. It was used to allay thirst, feverishness, pain, cough and distress of breathing. For many centuries China has used large quantities of liquorice, and many preparations of it are still sold in Chinese apothecary shops. Glycyrrhiza plays an important part in Hindu medicine and is one of the principal drugs of the 'Susruta'. In ancient Egypt, Greece and Rome glycyrrhiza was also frequently used. Evidence shows that it was much used in Europe in the middle ages. It is interesting to find that even to this day liquorice is maintaining its place in medicine and pharmacy.

The dried roots of this plant are commonly sold by drug sellers in the Indian bazars. Indigenous liquorice is obtainable

in the Peshawar valley and is met with in the Sub-Himalayan tracts from the Chenab eastwards, and grows throughout Burma and the Andaman islands. The main supply of the root, however, is not obtained from the natural sources existing in India but is imported from the Persian Gulf, Asia Minor, Turkestan, Siberia, etc. It is also cultivated in China, France, Germany, Italy, etc. The preparations of liquorice are very popular in Western medicine as a mild laxative. They are also largely used as constituents of cough syrups, throat lozenges and pastilles. The chief role which liquorice is playing in pharmacy at the present time is in covering the acrid taste of many nauseous drugs, particularly senna, aloes, chloride of ammonium, senega, hyoscyamus, turpentine, etc. Dr. Geo. S. Keith has recently stated that for relieving pain, discomfort and other symptoms caused by acrid matter in the stomach, it is wonderful. It seems to remove the irritating effects of acids in a better way than alkalies. If this use of the drug is further substantiated by other workers in the field of medicine, liquorice may occupy a more important place in pharmacy than that which it now holds. It is used by the practitioners of the indigenous systems as a tonic, as a demulcent in catarrh of the genito-urinary passages and as a slight laxative. The importation of this drug is of some consequence from the economic point of view, as it is not only used in medicine, but has also been employed in the dyeing and the tobacco industries for many years. Only a small fraction of the drug is collected in the country, large quantities of the crude drug and its preparations are being imported. The plant is easy to grow, especially in river valleys in hot regions. A deep and moderately rich loamy soil is required ; it should be planted before the commencement of the rains ; the underground stems and roots may be collected in the next autumn provided the growth is vigorous. It is difficult to estimate how far the cultivation of liquorice would be a commercial success.

References :—

(1) Beal, G. D., and Lecey, H. T., 1929, *Amer. Pharm, Assoc.*, Vol. XVIII, Feb.

HEMIDESMUS INDICUS (N.O. Asclepiadeæ)

Indian Sarsaparilla

VERN.—Sans.—*Ananta, Sariva ;* Hind.—*Magrabu ;* Beng.—*Anantamul ;* Tam.—*Nannari ;* Pers.—*Aushbahe-hindi.*

Sarsæ radix is obtained from *Smilax ornata,* N.O. *Liliaceæ,* a climbing plant indigenous to Costa Rica, and from other similar species found in Central America. It is commonly known as 'Jamaica' sarsaparilla because it was formerly exported by way of Jamaica to various countries. *S. officinalis* comes from Honduras, but *S. ornata* is considered to be the best commercially.

This plant has had a vague reputation in the treatment of nutritional disorders and syphilis for ages. It is also used in chronic rheumatism, skin affections and as a blood purifier. Recent researches have proved conclusively that the active principles of sarsaparilla consist of an enzyme, an essential oil and a saponin, none of which has any action in syphilis and other conditions for which it is used. In spite of this it is largely used and a number of expensive preparations are on the market. Large quantities of sarsaparilla and its preparations are imported into India annually. From the reports of the sea-borne trade of British India it appears that sarsaparilla to the value of Rs. 40,000/- or more was regularly imported annually into India during the last 5 years.

Two plants allied to sarsaparilla grow largely in India; these are *Saccolabium papillosum* and *Hemidesmus indicus.* The root of *Hemidesmus indicus,* known as 'Indian sarsaparilla', has long been employed in Southern India as an alterative and tonic. It is a climbing plant plentiful in Northern India, common in Bengal, and in the Deccan extending to Travancore and Ceylon ; it also grows in the Bombay Presidency. In commerce it is met with in small bundles consisting of tortuous roots and root bits of one or more plants bound together with a wisp of the root stem. Its properties were recognised by the medical profession in Europe and as early as 1864 it was made official in

the British Pharmacopœia. Clinical trials show that its medicinal value is in no way inferior to sarsaparilla.

References :—

(1) *Sea-borne Trade Report of British India* (Bengal Government Publication), 1928-29; (2) Power, F. B., and Salway, A. H., 1914, *J. C. S. Trans.*, p. 201.

HYOSCYAMUS NIGER (N.O. Solanaceæ)

Henbane

VERN.—Sans.—*Parasikaya* ; Hind.—*Khurasani-ajvayan* ; Beng.—*Khorasani ajowan* ; Bomb.—*Khorasani-owa* ; Tam.—*Kurasaniyomam*.

The seeds of hyoscyamus have been used by the Mohammedan physicians for a long time, but although it is a native of the Himalayas it does not appear to have been used in the Hindu medicine. Several species of hyoscyamus grow in India. Three species have thus far been recognised. *H. niger* occurs in the temperate Himalayas at an altitude of 6,000 to 12,000 feet above the sea level. In Kashmir, it is found wild in many places on rubbish heaps, dry drains, outskirts of villages, etc. Its distribution extends all over the temperate Western Himalayas from Kashmir to Garhwal. *H. muticus* grows in large patches along the river banks in the west of the Punjab and Sind, and *H. reticulatus* in Baluchistan and Khorasan.

The alkaloidal content of these plants, however, is lower than the standard laid down in the British Pharmacopœia. Even the samples of *H. niger* from Kashmir analysed at the Calcutta School of Tropical Medicine & Hygiene showed 0.03 per cent. of the total alkaloids as compared with 0.065 or more occurring in the specimen used in the Pharmacopœia. From its low alkaloidal content it might be thought that the Indian hyoscyamus would not be able to compete successfully with the European variety. In view of the abundant natural supply and the low price of the drug in India, which not infrequently

means only the transportation charges, this may not be true. Besides this, *Hyoscyamus niger* can be easily cultivated in a sandy loamy soil and this was successfully carried out in India as early as 1893. It was grown at the Royal Botanical Gardens in Calcutta, and also in Bombay, Ajmere and several other places. Under the auspices of the Indigenous Drugs Committee (1892), liquid extracts prepared from the cultivated hyoscyamus were sent to several provincial medical store depots for clinical trials and very encouraging reports as to their efficacy were received. In spite of this, the cultivation decreased and Watt in his *Dictionary of the Economic Products of India* (1898) remarked: "At present no hyoscyamus leaves of Indian origin are obtainable in India for medicinal purposes. The seeds obtained in the bazar also appear to be principally imported from Persia and Afghanistan, so that at the present day almost all the hyoscyamus employed in the Western medicine comes from Europe and even the seeds offered for sale in the bazars are not obtained in this country." It is difficult to understand why this was so in view of the fact that the plant was found growing wild in great abundance in the Himalayas, and the supply ought to have been commensurate with the rather meagre demand. This position is gradually changing, as the Government Nursery at Saharanpur and the Kashmir State authorities are systematically cultivating the drug and from both these places excellent crops of the drug are being obtained. The alkaloidal content of the cultivated plant has also increased and it is reported that it comes up to the standard of the imported variety used in the British Pharmacopœia. Private growers in the neighbourhood of Saharanpur have also paid some attention to the cultivation of the drug. In sugar-cane plantations there the crops have done well with the result that Saharanpur is now the chief source of supply of hyoscyamus in India. There is also a likelihood of hyoscyamus growing as a subsidiary crop in the tea plantations at higher altitudes, and if care is taken to avoid leaf flies and caterpillars from damaging the leaves and tops, it should do well. Indian grown leaves are now available on the market and tinctures and extracts

prepared from these are coming more and more into use by the medical profession. Considerations of price, however, may stand seriously in the way of the Henbane growers in Saharanpur. It is reported that European henbane can be had in Calcutta at a cost of -/5/6 annas per pound, whereas Saharanpur henbane is only available at about -/13/- annas per pound. If this statement is correct, it becomes apparent that Indian hyoscyamus will fail to find a ready market even in India in the near future. Attention should be directed towards decreasing the price of the drug by curtailing the transport and other minor charges.

References :—

(1) Dunstan and Brown, 1899, *J. C. S. Trans.*, p. 72; (2) Dutt, 1924, *Commercial Drugs of India;* (3) Chopra and Ghosh, 1926, *Ind. Jour. Med. Res.*, Vol. XIII.

IPOMÆA TURPETHUM (N.O. Convolvulaceæ)

VERN.—Sans.—*Trivrit* ; Hind.—*Pitohri, Nisoth* ; Beng.—*Teori* ; Bomb.—*Nishotar* ; Tam.—*Shivadai* ; Punj.—*Chitabansa*.

IPOMÆA HEDERACEA (N.O. Convolvulaceæ)

VERN.—Hind. & Beng.—*Kaladanah, Mirchai* ; Bomb.—*Kaladanah* ; Tam.—*Jirkivirai* ; Punj.—*Bildi*.

Ipomœa turpethum or Turpeth has long been used in India as a cathartic but it is not officially recognised in the pharmacopœias. It is found throughout India, ascending to altitudes of 3,000 feet. The resinous substance (turpethin) which the root bark of this plant yields is an excellent substitute for jalap (*Ipomœa purga*) and deserves more attention from practitioners. The seeds of *I. hederacea* (kaladana) have also been credited with a purgative principle and have been used as a substitute for official jalap. Many early European workers have testified to the utility of the powdered

seeds of *I. hederacea* in constipation. In spite of this, *Ipomœa purga* or *I. muricata* are imported either from Europe or Persia in large quantities and are found in Bombay. The properties of the indigenously growing Ipomœas were not sufficiently recognised in the early days and in view of its great demand attempts were made at that time to cultivate the true *I. purga* from the Mexican Andes in India. It was actually introduced into the Himalayan valleys in the middle of the nineteenth century but the experiment did not prove a success, in any case the yield was not up to the expectation and was not enough to supply the demands. In the Ootacamund gardens the plant grew better and gave better promise of a fair return on the outlay, even at the price allowed by the Medical Stores Depot which was much below the usual market price. The cultivated jalap was found to be as rich in the purgative resins as the best kinds imported from South America. In spite of the fact that good substitutes for jalap exist in India and grow in a state of nature and that the official *Ipomœa purga* can be successfully grown in different places of India, this country imports large quantities of *I. purga* from Mexico. The requirement of jalap is very large indeed as it is one of the most commonly used amongst the drastic purgatives of the Pharmacopœia. According to Watt about 2,000 pounds of dried roots were required in Bengal alone about the year 1854. This demand must have considerably increased now with the increase of population and the wider recognition of Western medicine. One of the factors which militated strongly against the popularity of *Ipomœa turpethum* is the adulteration and substitution practised frequently by the drug vendors of India. Most of the turpeth available in the market consists of aerial stems or a mixture of stems and roots, and not of the roots which alone are rich in the purgative principle. If attempt is made to obtain the active roots only, *Ipomœa turpethum* would most likely be in a position to stand on a level with the imported *I. purga* or *I. muricata*.

References :—

(1) Dutt, 1928, *Commercial Drugs of India.*

JUNIPERUS COMMUNIS (N.O. Coniferæ)

VERN.—Hind.—*Aaraar* ; Punj.—*Petthri, Pama* ; Kashmir—*Nuch, Pama* ; Arab.—*Habbul-aaraar.*

Juniper berries and the oil extracted from them are very ancient remedies and were known to the ancient Greeks. They used the drug for its diuretic as well as its digestive properties. *Juniperus communis* occurs widely throughout Europe, Siberia, India and North America. The Italian berries, however, are most valued for their oil. The extraction of the oil for medicinal and commercial purposes is done in Hungary, Italy, Russia, Bavaria and Sweden. Hungary is the chief country of production and a considerable external trade exists in this oil. In India, several species of juniper are found in the Western Himalayas, Kumaon and the Kurram valleys at an altitude of 11,000 ft. above the sea level. They do not appear to be much used in medicine locally, though the berries are sold in the bazars by the Mohammedan druggists. Simonsen studied the oil from the berries of *Juniperus communis* obtained from the upper Bashahr division and found that about 0.2 per cent. of the oil could be obtained. This yield is low as compared with the yield from the other continental plants; thus the Italian berries yield 1.0 to 1.5 per cent., Bavarian 1.0 to 1.2 per cent., Hungarian 0.8 to 1.0 per cent., Swedish 0.5 per cent. approximately.

Leaving aside the question of poor yield of oil, the Indian juniper oil corresponds closely to the foreign varieties except in certain constituents which have been given below :—

	Hungarian	Italian	Indian
Specific gravity at 20°	0·867	0·866	0·8788 (at 30°)
Optical rotation ...	−12°	−9·82°	Not determined as the oil is dark
Saponification value ...	5·9	6·1	21·2
Saponification value after acetylation ...	20·9	21·3	49·1

The differences might probably be accounted for by the particular liability of juniper oil to change on keeping. The differences are minor and the Indian oil possesses practically

the same proportion and character of the alcohol and esters to which the flavour of the oil is chiefly due.

Two species of juniper commonly growing in Kashmir, namely *J. communis* and *J. macropoda,* were tested at the Calcutta School of Tropical Medicine. In general appearance, there was not much difference between them in their berries excepting that the latter are somewhat longer in shape. The amount of volatile oil obtained by steam distillation was 0.25 per cent. and 3.24 per cent. respectively from *J. communis* and *J. macropoda.* The colour, odour and solubility of the oils were almost the same as that of the official oil of juniper. The oil from *J. macropoda* showed some difference in optical rotation and other minor physical properties. The characteristics of the oil are given below for comparison with the standard laid down by the British Pharmacopœia :—

	J. communis (B. P. standard)	J. macropoda
Optical rotation . .	−3° to −15°	−24 3°
Specific gravity . .	0.86 to 0.89	0.912

In spite of the similarity in the physical and chemical properties which the Indian oil shows, very little attempt has been made to utilise the juniper berries or the juniper oil in commerce. Juniper berries are rich in sugar and by their fermentation and distillation the well-known beverage 'gin' is obtained which owes its characteristic flavour to the oil of juniper. There appears to be a large demand for the berries in the western markets. The possibilities existing in this direction in India are worth exploring.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Chopra, Ghosh and Ratnagiriswaran, 1929, *Ind. Jour. Med. Res.*, Vol. XVI, p. 3.

MENTHA ARVENSIS (N.O. Labiatæ)

The Marsh Mint

VERN.—Hind.—*Pudinah* ; Beng.—*Pudina* ; Bomb.—*Pudinah* ; Tam. & Tel.—*Pudina* ; Pers.—*Pudinah.*

A number of species of mentha grow in India. *Mentha viridis* (spearmint), *M. incana* (peppermint), *M. sativa* and

M. aquatica occur as garden plants. *M. arvensis* grows very abundantly in the Northern and Western Himalayas in a state of nature. It is found in Kashmir at an altitude of 5,000 to 10,000 feet. The drug was well-known to the Greeks and Romans and was used not only for flavouring foods but also for medicinal purposes. Although many species of this plant grow in India the Hindu physicians do not appear to have used it in their medicine. *M. arvensis* is, however, now used as a domestic remedy in India on account of its stimulant and carminative properties.

M. arvensis growing in the Himalayas yields an oil which is similar to the peppermint oil derived from the official *M. piperita*. Peppermint oil (oleum menthæ piperitæ) is largely used in India in pharmaceutical preparations to disguise the taste of evil-smelling and unpleasant drugs and also as a carminative. As a flavour in confections and dentifrices also it is used to a very large extent. It has, therefore, some economic importance. Researches carried out at the Calcutta School of Tropical Medicine show that the essential oil obtained from *M. arvensis* by steam distillation compares very favourably with the oil obtained from *M. piperita*. The oil has the same odour, taste and other physical characters as the peppermint oil used in the British Pharmacopœia, and crystals of menthol can be easily obtained from it on keeping for some time. The amount of essential oil obtained from the whole dried plant from Kashmir was 0.18 to 0.2 per cent. This compares favourably with the average yield from some of the American sources, as will be seen from the following table:—

Source	Yield of Oil
Arlington Farm (America)	0.12—0.13 per cent.
Webster, South Dakota (America) ...	0.10 ,, ,,
Glenndale (America)	0.11 ,, ,,

It is likely that specimens of fresh herb will give a higher percentage of oil than that obtained from the dry herb extracted at the School, as it is stated by some authorities that the drying of the herb before distillation results in a loss of 50 per cent. of the oil.

As a result of extensive researches carried out by the United States Department of Agriculture, it has also been found that if the leaves are collected during the budding and flowering stages, the yield of

oil on distillation is much higher than the figures given above The following table shows some of the results obtained by the American workers :—

Stage		From entire plant per cent.	From leaves alone per cent.	From the tops per cent.
Budding	..	0.116	0.203	0.173
Flowering	..	0.113	0.303	0.233
Fruiting	...	0.133	0.120	0.153

It is, therefore, quite probable that if similar precautions are taken with regard to the Indian plant, the yield of oil will be still further improved. Moreover *M. piperita* can be easily grown as a garden plant in temperate climates. Its cultivation is not difficult and requires only the usual attention given to such crops as corn, potatoes, etc. Any marshy soil situated along the banks of rivers, provided it is dry and well-drained, is suitable. According to a recent report by the Ministry of Agriculture, London, any light calcareous soil, friable sandy loams or gravels may be used for cultivation of mint. Soils of the above description are not difficult to find in a vast country like India. Many years ago experiments were carried out with a certain degree of success in growing the plant in the Nilgiri gardens for the purpose of obtaining the oil for the Medical Stores Department of the Government of India. An excellent quantity of oil was obtained and there is no reason why this industry should not be successfully developed. The methods of planting, cultivating, harvesting and distilling have been worked out through years of trial and experiment in other countries and could be easily taken advantage of in India.

Economic Aspects :—Peppermint oil of commerce is derived chiefly from two botanical sources—(1) The English, European and American oils from *M. piperita* and its varieties, *officinalis* and *vulgaris*, and (2) the Japanese oil from *M. arvensis* (var. *piperascens*, Holmes) or from *M. canadensis* (var. *piperascens*, Briquet). English peppermint oil occupies a unique position. It is admittedly superior to any other kind and commands a much higher price. Much adulteration of the English with American oils takes place.

Japanese oil has a strong, characteristic, herby odour and a somewhat pungent taste, and these properties readily distinguish it from the English and American oils. It is rich in menthol content and readily crystallises to an almost solid mass on cooling. The oil is not included at present in the British or the American Pharmacopœia which recognise only the oil derived from *M. piperita*. This cannot, therefore, be used in official medicine but it is probable that it will be recognised and accepted in the near future. In spite of this, however, it is very largely used, as will appear from the total export figures from Japan in 1926:—

Peppermint oil	637,203 lbs.
Menthol	705,371 ,,
Menthol pencils	176,668 ,,

At present, the main supply of the oil comes from Japan, which provides about 80 per cent. of the world's requirements. Next to Japan, America is the largest producer of mint oil. The cultivation of peppermint in the United States began as early as 1816 and is zealously carried on even to this day. The plant is scientifically cultivated mostly along the Pacific coast and the production of mint has reached a satisfactory figure. The *Bureau of Plant Industry Bulletin* of 1914 states that there are some 25,000 acres under cultivation; the average yield of oil per acre is 30 lbs. and the annual product has been recorded as 250,000 lbs. of oil. Since then the annual yield has increased very greatly as nearly 600,000 lbs. of oil were distilled in 1926. America not only supplies her own somewhat extensive needs but also carries on a huge export trade in the oil. This may be estimated from a study of the export of peppermint oil from the United States which in 1923 was 102,507 lbs., in 1924 was 159,729 lbs. and in 1925 was 127,218 lbs.

Both Japan and the United States derive a large profit from the sale of peppermint oil. England, France, Italy and Germany also possess flourishing industries in mint oil. Australia recently has been experimenting somewhat extensively on the production of oil of peppermint and the published

reports indicate very favourable results. Within the last few years, cultivation of peppermint has been taken up in Roumania on an experimental scale and it is said that the experiment has succeeded remarkably. In view of the large natural resources existing in India and in view of the fact that the average price for peppermint oil is steadily on the increase, India should not remain behindhand in this industry. Cultivation of mint in suitable localities and distillation of the oil in India for commercial purposes would certainly have been a remunerative enterprise, well worth taking up, but the position of the trade is at present changing to a very great extent.

In these days large quantities of menthol are being produced synthetically. This process is easily carried out by reducing ketones such as menthone, pulegone and piperitone. Piperitone is contained in eucalyptus oil and to a certain extent in the dementholised oil produced in Japan and can be easily converted into menthone, which in its turn can be changed by catalytic hydrogenation into menthol. The product by this method is what has been appearing during the past several years on the market as synthetic menthol.

Pulegone is the principal ingredient of pennyroyal oil, (*Mentha pulegium*) and will be found to a noticeable degree in the Japanese peppermint herb. Like piperitone, this can be changed into menthone. Citronellal, much of which is found in citronella oil (from citronella grass, *Cymbopogon nardus*) produced in Java and Ceylon, can also be used in the preparation of menthol.

According to Schimmel & Co's reports synthetic menthol produced in their laboratories is laevo-rotatory with a melting point of 35°C and in appearance and odour it is very similar to the natural menthol. Tests have further shown that the synthetic product is slightly more active physiologically but less toxic than the natural product. Its antiseptic properties are similar to many of the following drugs, *e g.*, acriflavine, scarlet red, gentian violet, etc. As matters stand at present, it is not possible to forecast the possibilities of the natural menthol industry. The rate at which the synthetic article is being produced and boomed in the market augurs very unfavourably for the natural product.

References :—

(1) Russel, 1926, *Jour. Amer. Pharm. Assoc.*, Vol. 15, p. 566; (2) *Bureau of Plant Industry Bulletin*, 1905, Part III; (3) Finnemore,

1926, *The Essential Oils;* (4) Schimmel & Co., 1928, *Report;* (5) Chopra, R. N., Ghosh, N. N., and Ratnagiriswaran, A. N., 1929, *Ind. Jour. Med. Res.*, Vol. XVI, Jan.; (6) *Perfumery and Essential Oil Records,* 1923, Vol. 14, p. 397; (7) *Chemist and Druggist,* 1926, Vol. 104, p. 278.

*MYLABRIS (Order—Coleoptera)

Mylabris chicorii & Mylabris pustulata

Cantharidin is well-known in Western medicine and is widely employed in the form of plasters for its counter-irritant, rubefacient and vesicant properties. It is contained in more than a dozen medicinal preparations, most of which are meant for external application. Owing to its irritating properties, internal administration is not common but in small doses it has been often used, alone or in combination, in such diseases as lupus, cystitis, incontinence of urine, spermatorrhœa, etc. Its use as an ingredient of hair lotions, hair oils and several other cosmetic preparations like pomades, etc., appears to be getting more and more popular every year.

Cantharidin is a colourless crystalline lactone derived originally from the dried Spanish beetles known as *Cantharis vesicatoria.* These beetles are from 18 to 25 mm. long and about 6 mm. broad, smooth and of a shining green or bronze green colour. They are widely distributed over Southern Europe, living gregariously in olive trees, ash trees, etc. The ordinary practice is to collect the beetles on cloth spread out below the plants to which the insects are thrown down by shaking the plants. It is better to capture them before sunrise while they are unable to use their wings. They are then killed by means of ammonia, vinegar, sulphur dioxide or by heat and cantharidin is extracted from these beetles after they are thoroughly dried in the sun. Most of the cantharidin exists in the free state and only a very minute quantity is in combination as salts.

Several species of blistering beetles are found in different parts of the world. In China and in the Far East, Mylabris beetles are available in considerable quantities. These beetles

*Animal product.

differ from the Spanish beetles in being larger, broader and in having much darker upper wing-cases, but they belong to the same large order of insects known as *Coleoptera*. *Mylabris sidae* (*M. phalerata*) and *Mylabris chicorii* are the two varieties available in China and their collection for purposes of export to other countries is a regular business there and is said to be quite remunerative. In India, *Mylabris chicorii* (Vern.—Teleni makhi), and *Mylabris pustulata* are found in enormous quantities. *Mylabris pustulata* has recently been collected in fairly large quantities in fields of cereals and vegetables in the neighbourhood of Bangalore by Iyer and Guha (1931). *Mylabris chicorii* occurs abundantly during the rainy season in certain parts of Northern India and Kashmir, but no systematic attempt has thus far been made to collect them and utilise them for medicinal purposes. At present, the dried insects or cantharidin preparations are imported from other countries at a high price in spite of the fact that an ample supply of blister beetles is available in India. Sometime ago, the Government Medical Stores obtained their supplies from the neighbourhood of Gwalior where these beetles make their appearance in the fields of maize in July, but it is understood that the practice has been discontinued lately. Very little has been done towards systematic collection of the beetles and the main difficulty of the pharmaceutical chemists who wish to manufacture cantharidin lies in getting a regular supply of the indigenous beetles. That cantharidin could be successfully extracted in India was convincingly shown as early as 1907 by Puran Singh. A firm of manufacturing chemists in Calcutta actually prepared the drug and offered it for sale to the public but this has been discontinued on account of foreign competition. Recently, Iyer and Guha (1931) working in the Indian Institute of Science, Bangalore, have shown that the Indian beetle, *Mylabris pustulata* yields about 2.9 per cent. cantharidin as compared to the maximum yield of 1.9 per cent. from Chinese beetles. The yield from the Spanish beetles is even less (1.2 per cent. approximately). As the cost of laboratory production, representing labour of collection and value of materials, without deduction for recovery of ethyl acetate

(obtained as a bye-product), amounts roughly to 6 annas per gram, the production of cantharidin from the indigenous sources is bound to succeed at the present market price of imported cantharidin at Rs. 2-3-0 per gram. There is also an indirect benefit to be derived. The collection of these herbivorous beetles for cantharidin extraction would be of great benefit to the agriculturists by removing a serious menace to crops and gardens.

References :—

(1) Dutt, 1928, *Commercial Drugs of India;* (2) Puran Singh, 1907, *Records of Imperial Forest Research Institute,* Dehra-Dun; (3) *British Pharmaceutical Codex,* 1923; (4) Iyer and Guha, 1931, *Journ. Ind. Inst. Sci.,* Vol. 14A, Part III, p. 31.

MYRISTICA FRAGRANS (N.O. Myristiceæ)

The Nutmeg ; Mace.

VERN.—Sans.—*Jati-phalam* ; Hind. & Beng.—*Jayphal, Jaiphal* ; Bom.—*Jaiphal* ; Tam.—*Jadikkay* ; Tel.—*Jajikaya.*

Myristica malabarica or Bombay mace

Myristica or nutmegs are not very much used in medicine but the volatile oil derived from them enters into several important and widely used pharmacopœial preparations like spiritus ammoniæ aromaticus, tinctura valerianæ ammoniata, etc. The oil is also used in aperient pills and other preparations to prevent griping and is given on sugar as a stimulant and carminative. Apart from purely medical use, the nutmegs form an important article of commerce in that the essential oil is highly prized in the soap and perfumery industry.

The cultivation of nutmeg is principally confined to the Moluccas, but the tree grows also in Penang, Sumatra, Singapore, Ceylon and the West Indies and has been introduced into Mauritius, Bourbon, Madagascar, the Seychelles and Zanzibar. Several species are found in India in the Nilgiri hills and the Malabar coast. It appears from ancient records that the nutmeg tree flourished in India at one time. As early

as the sixteenth century, Garcoa de Orta, a Portuguese physician found nutmeg trees growing luxuriantly in the Indian soil, but at present these are never found in abundance. A variety of nutmeg, *M. malabarica* is available in large quantities in Bombay but is deficient in that delicate aroma which characterises the *M. fragrans* and is consequently of very little commercial value. It is known as 'Bombay mace' and is used as an adulterant for *M. fragrans*. The economic importance of the oil of nutmeg may be estimated from the fact that, the United States alone, on an average imports between 2,000,000 to 3,000,000 lbs. from foreign countries annually. Moreover, nutmegs worth Rs. 6,62,667 were imported into India in the year 1928-29, so that if better attention is paid India might not only supply her own demands but have the prospect of an export trade of some consequence.

Myristica fragrans can be usefully cultivated near the sea along the eastern and western coasts of India. It grows in widely different types of soil, *e.g.*, rich, volcanic sandy soil in Moluccas, to yellow, loamy clay in Penang. It is yet too early to pronounce with any degree of certainty the possibility of successful nutmeg cultivation in India, but further investigations into the matter are certainly needed.

References :—

(1) Finnemore, 1926, *The Essential Oils.*

PAPAVER SOMNIFERUM (N.O. Papaveraceæ)

The Opium or White Poppy

VERN.—Sans.—*Ahiphena* ; Hindi.—*Afim, Afiyun* ; Beng.—*Posto-dheri* ; Bomb.—*Aphim, Appo* ; Tam.—*Abini, Gashagasha* ; Pers.—*Afiun, Khash-khash* ; Arab.—*Afiun, Qishrul-khash-khash.*

Papaver somniferum, var. *glabrum* or the opium poppy grows in any part of India. It has white flowers and white seeds called *Khaskhas* ; the poppy capsules are called *postdoda.*

It is generally cultivated and does not occur in a state of nature. Probably the plant is not indigenous to the country but was imported. It is clear from historical records that its introduction dates long before the British rule was established. The properties and uses of the capsules of the opium-yielding poppy were known long before the Christian era. According to De Candolle, *Papaver somniferum* or opium-yielding poppy is probably the cultivated state of *Papaver setigerum*. Various species of the poppy have been cultivated as ornamental garden plants and have been mentioned by the writers from the earliest times. There is little doubt that the merits of the seed as a food were recognized much earlier than the somniferous property of the capsules and it is also certain that the soporific and narcotic properties of the capsules themselves were appreciated long before their recognition in its milky sap. The capsules have been employed in the preparation of soporific drugs or in the preparation of stimulating and soothing beverages from times immemorial. According to Watt, *Papaver somniferum* was grown in Asia Minor many centuries ago for its capsules, and the Arabs carried the dried poppy heads to the eastern countries including China even before the inspissated juice was taken and its properties made known to the inhabitants of those regions. The medicinal properties of the plant and its capsules were fully known during the early classic period of Greece and Rome. One of the earliest references to opium appears to be about the time of Theophrastus who lived in the beginning of the 3rd century B. C. and who seems to have been acquainted with the preparation and uses of the juice of the poppy. There appears to be no doubt that the value of the seeds and capsules was known prior to that. The Egyptians used poppy capsules in the 1st century A. D. The early Chinese works mention the Arabs exchanging poppy heads with Chinese merchants. When the capsules were first shown to them, their urn-like shape and millet-like seeds suggested the name *minang* (millet vessel) and *yingsu* (jar millet). There are records to show that the Arabs instructed the Chinese to prepare from these capsules a soporific beverage and medicine before they knew anything about the

properties of opium. There appears to be no doubt that the word *ya-pien* (Opium) followed the word *mi-nang*.

It will thus be seen that the capsules of the poppy attracted the attention of the human race long before opium was known. Little wonder then that after their narcotic and soothing properties were appreciated by those practising in the healing art, they became known to the laity who made use of them for purposes of satisfying the almost universal desire which human beings possess for a stimulant or a sedative.

Medical Uses of Poppy Capsules:—Poppy heads are not commonly used nowadays in medicine but we have referred to their employment for medicinal purposes in the early classic Greek and Roman periods as well by the Egyptians during the reign of the later dynasties. The capsules have been used in the Hindu medicine and in the Mohammedan medicine for many centuries as a sedative both for internal use and external application. The Hakims prescribe them for headache, diarrhœa, dysentery and digestive troubles in children. They are used as a household remedy in many parts of India and are given during the teething periods by mothers to their children to keep them quiet. An infusion prepared from the poppy heads is used as a soothing application for bruises, inflamed, excoriated and swollen parts and sometimes as an application for various forms of painful conjunctivitis, inflammation of the ears, etc. Fomentations with poppy heads are even now applied to painful inflammatory swellings. Even in China the physicians used them freely in the early centuries of the Christian era. Most of the Lung dynasty medical writers and from them downwards extol the merits of poppy capsules in the treatment of dysentery, especially when combined with astringent drugs. The Chinese writer Wang-Shih said that the effects of poppy capsules in dysentery were magical. According to Dr. Edkins both the red and white forms of poppy were certainly described and used in the Chinese medicine in the 11th century before opium was known. A medical author of the Yuan dynasty (13th century) describes the preparations of poppy capsules as being a very effective remedy against dysentery.

Use of Poppy Capsules for Euphoric Purposes :—It is well-known that the use of articles of stimulative, restorative or sedative character, is bound up with the natural history of human beings from the very earliest times. The use of such articles as cocoa, coffee, tea, opium, alcohol, etc., to procure an added feeling of pleasure has been known long before the history of civilization. All of them, in moderate quantities, produce a favourable effect on mental conditions of man. Whether they have a stimulating or a depressing effect on the central nervous system, they all produce an enhanced sense of well-being or euphoria. The capsules of the poppy were used very early for this purpose. Whatever might have been the case in the countries of its origin (*e.g.*, Asia Minor) there appears to be little doubt that poppy heads began to be used for euphoric purposes in India soon after the introduction of the poppy plant in the country. There the plant was known as *koknar,* the capsules were called *goza, khol-i-koknar* or *post-i-koknar* or simply *post* or *post doda.* In the time of the Moghuls a beverage made from the poppy capsules known as 'kuknar' was very commonly used throughout the country. Abul-Fazl in his *Ain-i-akbari* mentions about the Emperor himself taking this drink. He says, "Whenever His Majesty is inclined to drink wine, or take opium, or kuknar, trays of fruit are set before him". The use of the word 'kuknar' apart from opium in the above passage shows that both the poppy capsules and the inspissated juice or Afyun were used. According to Watt, the beverage 'post' at present taken in the Punjab closely resembles 'kuknar' which was a luxury among the Mohammedans in the time of Akbar. There is also mention of a beverage known as 'Char-bughra' which was a mixture of wine, hemp, opium and poppy capsules. Many other references in the Moghul literature indicate the extent to which the habit of drinking 'post' or 'kuknar' prevailed among the Indians during the 16th century and later. Bontius, writing of Batavia in 1658, divided the Indians into 'Posti', *i.e.,* those addicted to poppy capsules and 'Afyuni' or those taking opium. During the 17th and 18th centuries the use of 'post' was very prevalent as is evident from the remarks of various writers of that period. The people in those days grew poppy and used it in any way they liked; the use of the capsules for euphoric purposes appears to have been very prevalent for that reason. In the history of the Punjab during the time of the Sikhs there are many references to 'post' drinking, but it is impossible to form an idea as to the extent to which the habit prevailed among the people. Since the introduction of restrictions in the cultivation of the poppy the temptation has been undoubtedly removed from the doors of the peasant and there is no doubt that the habit has considerably decreased for that reason. Poppy heads are obtained now with difficulty and in most parts of India the beverage 'post' or 'kuknar' has become unknown and appears to have been replaced by opium. It has thus come about that

the use of poppy capsules or 'post' has become very uncommon in this country. It is still indulged in some districts of the Punjab, chiefly Jullunder and Hoshiarpur, and in some of the Rajputana States.

OPIUM :—Opium is the air-dried, milky exudation obtained by incising the unripe capsules of *P. somniferum*. The standard product in its normal moist condition contains not less than 9.5 per cent. of anhydrous morphine but the yield may vary from 2.0 per cent. to 22 per cent.

The earliest mention of opium, as a product of India, was made by the traveller, Barbosa, in his description of the Malabar Coast in 1511, and the Portuguese historian, Pyres, in a letter to King Manuel of Portugal in 1516 spoke of opium of Egypt and Bengal. An excellent account of the history of the cultivation of the poppy and of opium eating and smoking is given by Watt in his *Dictionary of the Economic Products of India.* The author traces the history of the poppy from the time it was grown as a garden plant even before Greece and Rome knew anything about its medical properties. He states that the Swiss lake-dwellers of the Stone Age cultivated a poppy which is nearer to *P. setigerum*. The investigations of Unger (1857) have failed to show that the ancient Egyptians knew of the properties of the poppy juice, nor is there any reference to opium in Egyptian literature. It seems probable that the Greeks were the first to discover opium. The word 'Ophion' in the Talmud is clearly borrowed from the Greek, and the Arabic word 'Af-yun' has the same origin. The original home of the poppy was probably Asia Minor and from there it appears to have been carried to Greece. Homer and Livy knew the medicinal properties of the plant and Dioscorides, who lived in the 1st century A. D., described in detail the extraction of opium. By the beginning of the Christian era, opium and its properties were universally known. During those days opium was chiefly produced in Asia Minor and its cultivation developed into a big industry. There also it attracted the attention of the nomadic Arab traders, who were responsible for spreading the knowledge concerning this drug, and for carrying it to the different countries in the East including India and China. They knew the secret of its dissipative effects and spread the drug habit to the remotest corners of Asia. It is borne out by the testimony of historical records that opium was unknown in China previous to 763 A.D. and there is evidence to show that it was introduced into the country in the 13th century. Early Chinese works mention that the Arabs exchanged poppy capsules for other forms of merchandise and the Chinese name 'Ya-pin' is evidently derived from the Arabic 'Af-yun'.

The history of the entry of opium into India is less definite than that of its entry into China. Some evidence has been adduced to show

that opium was known in India in the latter half of the 9th century and it was undoubtedly widely known in the country in the 15th century. When the Portuguese first came to Cochin in 1498, opium was an article of trade taken from Arabia to Calicut and other places. By the end of the 15th century, they had actually started growing opium in India. According to Professor Bloomfield no word equivalent to opium occurs in Sanskrit literature. It may accordingly be concluded that opium was not an indigenous product of India. It is only since the time of the Mohammedan conquest that the word 'Khash-khash' (poppy seeds) or 'Khash-khasharasa' (a juice of the poppy) begins to appear in Sanskrit literature, and all the vernacular names in India (Sanskrit 'Ahiphena' and Hindi 'Afim') are traceable to the Arabic word 'Af-yun'. The English word 'Opium' also appears to have the same derivation. This conclusively shows that it was introduced by the Mohammedans.

Opium in the Indigenous Medicine:—No reference has been made in the ancient books on Hindu medicine either to the poppy or its products. The exact time at which opium was introduced into the Ayurvedic medicine is difficult to determine. In the classic works of Chakradatta, Sushruta and Vagbhatta, no mention is found of opium. The last of these works is believed to have been written in the 6th century A. D. The author and the commentator who wrote Chakradatta in the 11th century, does not mention opium in this work. It is, however, contended that in a work on toxicology written by Narayan of Malabar about 862 A.D., the use of opium in the treatment of rat poison has been mentioned. In the later work such as Sharangadhara (14th and 15th century) and Bhavaprakash (16th century) opium is freely mentioned and is used in several preparations. It is probable, therefore, that opium came to India along with or a little before the Mohammedan conquest. Opium is not used to a very great extent in the Ayurvedic medicine at the present time, its administration being mainly confined to two diseases namely diarrhœa and dysentery and that only in certain stages. It is said to cure 'the concurrent derangement of the three humours, increase the seminal and muscular powers and produce stupefaction of the brain'. The curious fact is that the Hindu physicians appear not to have made use of the pain-relieving properties of opium.

In the Mohammedan medicine opium has been described as an anæsthetic and its pain-relieving properties were fully appreciated many centuries ago. It was prescribed in hemicrania, pain in the joints, lumbago, etc., and was not only given internally but was applied externally also in the form of a paint. It was also used in dysentery and diarrhœa. With regard to its action on the brain it was fully realised that it stimulates at first giving rise to a sense of pleasure and satisfaction, increase of physical vigour and a feeling of warmth; these properties give rise to habit formation. The narcotic properties of opium and its sedative action on the respiratory effects was fully appreciated and it was largely employed against severe cough, asthma and hiccough. The Mohammedan physicians also recommended it as an aphrodisiac, as it was believed to lengthen the time of seminal discharge during coitus. At the present time opium is used in combination with other drugs in the treatment of diabetes mellitus.

The investigations of the author show that opium is prescribed in the indigenous medicine to a very limited extent. It is not, as is commonly believed, very freely used by Kavirajes and Hakims so as to lead common people to resort to it.

Production of Opium in India:—It is possible to grow the poppy in a temperate or subtropical climate where the rainfall is not excessive. The yield is smaller in the temperate than in the subtropical regions. The first recorded instance of the cultivation of the poppy in India in the 15th century mentions Cambay and Malwa as the places where it was grown. After its advent into this country, it appears to have been cultivated primarily along sea-coast areas and penetrated later into the interior of the peninsula. It was the white variety of poppy that was and even now is largely grown, although it yields the least amount of morphine, the purple variety giving the highest yield (nearly 3 times as much morphine as the white variety) and the red variety coming in an intermediate position. This is due to the fact that the former is best suited to the climate and can be grown in almost any part of the country. The purple variety, however, grows luxuriantly in Rajputana

and Central India while the red-flowered variety with dark seeds is cultivated in the Himalayas.

So extensively was the poppy grown in the time of the Moghuls that opium became an important article of trade with China and other eastern countries. Malwa opium was characteristic of that part of the country. During the reign of the Emperor Akbar, its importance as a source of revenue was first appreciated and it was he who made opium a State monopoly. It is stated by Abul-fazl in *Ain-i-akbari* that poppy was cultivated in Fatehpur, Allahabad and Ghazipur. It was mainly grown in the Subhas of Agra and Oudh and Allahabad which comprised rather more than the area now included in the United Provinces. It was not grown in Bihar at that time, but later that province produced large quantities and cultivation spread extensively to other parts of India. Roxburgh, Elliot and Ainslie make no mention of the cultivation of opium in South India, but it appears probable that the poppy was grown in that part of the country. There is no doubt that it was extensively cultivated during the Moghul rule, not only in Bengal but in Orissa also. After the fall of the Moghul Empire, the State lost its hold on the monopoly and control over the production and sale of opium was appropiiated by a ring of merchants in Patna. In 1757, the monopoly of the cultivation of the poppy passed into the hands of the East India Company who had by that time assumed the responsibility for the collection of revenues in Bengal and Bihar. When Warren Hastings was appointed Governor-general, he brought the whole of the opium trade under the control of the Government. Since then, though changes have been made in the methods of control of production, distribution, sale and possession of opium, the monopoly has been solely in the hands of the Government and a strict control has been exercised in the best interests of the people of the country as a whole. Under the East India Company and afterwards under the Crown a general cultivation of the poppy and the production of opium were prohibited; these being restricted to three centres:—(1) Patna or Bengal opium, from poppy grown in Bihar and Bengal; (2) Benares opium, from the United Provinces; (3) Malwa opium produced in a large number of States of Rajputana including Gwalior, Bhopal, Baroda, etc.

During recent years, cultivation of the poppy has been almost entirely limited to the United Provinces of Agra and Oudh. Permission to grow the plant is obtained by a written license and the whole of the product is purchased by the Government. Opium grown in British India was and is strictly controlled, but difficulty arises with semi-independent Indian States which comprise the last source. During the last few

years, the Government of India has been making efforts to bring the cultivation of poppy in these States into line with that in British India and a certain amount of success has already been achieved.

Besides the Indian States, a certain amount of opium was also grown in the Punjab chiefly for internal consumption of the province, but this has now been practically stopped. Poppy was also grown throughout the length and breadth of the Himalayas especially in the Simla Hills, but in small quantities mostly for local consumption. The production from this source is also being carefully watched. The result of restricting the cultivation of the poppy is that not only is less opium produced, but also the temptation is removed from the peasants' door and, therefore, addiction in rural areas has considerably decreased. This factor has also altered the form of indulgence. It is clear from the historical records that a beverage made from poppy capsules and the plant under the name of 'post' or 'kuknar' was extensively indulged in the days of the Moghuls and later, throughout the whole country. This has now become practically extinct with the exception of 2 or 3 districts of the Central Punjab where cultivation of poppy is still allowed partly on religious grounds. The Government have under consideration the total prohibition of poppy cultivation in these areas also.

Decrease of Poppy Cultivation:—That the cultivation of poppy has enormously decreased during recent years can be proved by statistics which are now available. According to the figures collected by Watt in 1881, the total area under poppy cultivation in British India did not exceed 1,000,000 acres, and he estimated that it had been stationary for 30 years previously. The average yield per acre was about 15 to 20 lbs. of opium and it was calculated that roughly not more than 20,000,000 pounds of opium were produced. The Major part of this was intended for export, a comparatively small quantity being kept for consumption at home. Since that time there has been a progressive decrease which has been especially marked during the last decade.

It will be seen from the following table that during the last few years, the cultivation of poppy and the production of opium have fallen to less than half of what it was in 1920.

	Area under poppy cultivation	Opium produced
1881	536,282 Acres	7,800,521 lbs.
1920	154,621 ,,	1,870,436 ,,
1921	116,055 ,,	1,179,977 ,,
1922	117,932 ,,	1,518,828 ,,
1927	52,279 ,,	885,641 ,,

Both the export and the internal consumption of opium have decreased. A glance at the export returns will show that these have fallen very considerably. While in 1900-01, 69,708 chests were exported, in 1919-20 the number dropped to 10,509 chests and, in later years, it has been still further reduced. (Export chest contains 140 $\frac{1}{7}$ lbs.).

It will be seen, therefore, that the production of opium in parts of India under British administration, comprising an area of about two-thirds of the whole country, is strictly controlled and that the cultivation of poppy is being progressively reduced every year. A little over one-third of the country, however, comes under the control of Indian Princes, and over the growth of poppy in these States the Government of India had no control in previous years. While no opium produced within these territories can pass into British India or to any of the seaports, except under permit from the Government of India and on payment of very high duty, it is impossible for the Government of India to exercise any control over the production of opium there, for the purpose of internal consumption. In some of these areas such as Rajputana, very large quantities of opium are said to be consumed. The Government, however, are doing all that lies in their power to bring these States into line with the policy adopted by the Imperial Government in accordance with the terms of the Hague Convention and a number of the Indian States have already agreed to similar restrictions being imposed in their territories.

A conference was held in Simla in 1927 where the representatives of the different Indian States concerned were present and a committee was appointed to determine how the production of opium could be further reduced.

Chemical Composition:—Opium varies considerably in appearance, composition and quality according to its place of origin and the mode of its manufacture. It is grown in many parts of the world and chiefly in Turkey, Asia minor, Persia, India, China, Egypt and South Eastern Europe. In addition to a number of the alkaloids present in opium (mentioned in the table following) it contains acetic, lactic, sulphuric and meconic acids, gummy and pectinous substances, albumin, wax, fat, caoutchouc, resin, and several indifferent bodies, *viz.*, meconin, meconoisin.

The number of alkaloids so far identified and their proportions in opium are as follows:—

*Morphine ..	9 per cent.	Laudanosine	0.0008 per cent.
*Codeine ...	0.3 ,, ,,	Lanthopine ...	0.006 ,, ,,
Neopine—		Cryptopine ...	0.08 ,, ,,
*Thebaine ...	0.4 ,, ,,	Papaveramine—	
Porphyroxine—		*Narcotine ...	5 ,, ,,
Meconidine—		Gnoscopine ..	0.2 ,, ,,
*Papaverine ...	0.8 ,, ,,	Pseudomorphine	0.02 ,, ,,
Pseudopapaverine—		Tritopine ...	0.0015 ,, ,,
Codamine ...	0.002 ,, ,,	Hydrocotarnine—	
*Laudanine ...	0.01 ,, ,,		

*Those marked with asterisks are the most important.

The opium alkaloids are divided into two groups: (1) the phenanthrene-pyridine group comprising morphine, codeine, pseudomorphine, neopine and thebaine, (2) the benzyl-isoquinoline group consisting of papaverine, narcotine and most of the remaining alkaloids. The members of the first group are strong bases and very poisonous whilst the second group as a whole have little physiological action. The valuation of opium depends on the amount of morphine present in the sample—this being the most abundant and physiologically the most active of the alkaloids. The amount of morphine present in samples of opium from different countries is as follows:—

Turkey 5—14 per cent.; Persia 6—14 per cent.; Egypt 0.28—8 per cent.; India 3—15 per cent.; China 1.5—11 per cent.; Japan—0.7—13 per cent.; Bohemia 11—12 per cent.; Turkestan 5—18 per cent.; Australia 4—11 per cent.

Formerly it was believed that Indian opium, which was chiefly used for smoking purposes, had the smallest quantity of morphine and hence was unsuitable for medicinal purposes. Since 1914 special efforts have been made to produce in India opium suitable for medicinal purposes and the morphine content of the Indian drug has risen steadily. Indian opium can now compete with the best Turkish opium as regards its medicinal value. It has further the advantage of being richer in codeine than opium produced in other countries. The relative proportions of the important bases in the Indian and Turkish opium are given in the following table:—

	Indian Opium (average)	Turkish Opium (average)
Morphine ...	9.5—14.2 per cent.	10—14 per cent.
Codeine ...	1.8—4 ,, ,,	0.2—3.2 ,, ,,
Narcotine ...	3.9—7.6 ,, ,,	4—11 ,, ,,

Use of Opium for Euphoric Purposes:—The policy of the Government of India in respect of domestic consumption in India has been severely criticised. The Indian Government have held that the internal consumption of opium is a matter which entirely concerned the British and Indian Government and that it is not an international question. On the other hand, it is urged that the cultivation of poppy and the production and use of opium even within a country are not exclusively internal affairs as the effects of opium production and consumption flow to the outside world and it is, therefore, an international question for many reasons.

The control over the production of opium in India is very effective. From the very early days, the Government have realised that the availability of a drug in a locality determines the nature and the prevalence of addiction in that area. The necessity of restricting cultivation of the poppy to cut down opium consumption was fully appreciated by the authorities. The Governor-general, Lord Ripon, in a despatch to the Secretary of State many years ago, pointed out that unrestricted cultivation of poppy would stimulate the opium habit among the population. The cultivation of poppy was controlled as early as 1857 when a law was enacted to regulate opium production. Poppy cultivation is even now regulated by Act XIII of 1857 (as amended by Act I of 1911) and by Act I of 1878. Under these Acts the cultivation of poppy within British India is permissible only under license; the total area to be sown is fixed by the Government from year to year, and the license specifies the exact amount which the licensee may cultivate. With the exception of certain hill tracts

in the Punjab, where the people are allowed to grow poppy to a small extent and to sell the opium direct under Government control to licensed vendors, the cultivator is bound to sell the whole of his produce to the Government at a fixed rate. The exception in the case of the Punjab is now under consideration. The cultivation in the Ajmer-Marwara has been prohibited since January, 1927; and it is now confined to a limited area in the United Provinces.

The seed is sown in October and November. In December, the Opium Officers check and record the area under seed. The juice of the poppy is collected from January to March and is delivered from April to June. The whole of the juice extracted from the poppy must be delivered to the Government officers.

With regard to the distribution of opium, the *internal policy* of the Government of India was and is one of non-interference with the moderate use of raw opium whether the object of the consumer be some real or supposed physical benefit, or merely the indulgence of the almost universal desire of human beings (particularly those whose occupations involve exposure or severe bodily exertion) for a stimulant or narcotic. It is, and always has been, the desire of the Government to suppress excessive indulgence. The manufacture, possession, transport, import, export and sale of opium are strictly controlled under the Opium Act of 1878. An individual can obtain opium only from a licensed vendor or a licensed druggist. Each stage of distribution down to the retail vendor is safeguarded by an elaborate system of transport passes, while the conditions designed to restrict abuse of the license on the part of a retail vendor are most stringent. He may not sell to any one person at one time more than the quantity of opium that an individual may lawfully possess; he may sell only for cash and only on the premises for which he is licensed; he must not allow consumption on such premises and he must keep correct daily accounts of his sales, which are open to inspection by Excise Officers at all times. With regard to exports, the Government of India, as a result of an agreement concluded with the Chinese Government, began in 1908 to diminish progressively the total amount of opium sold in Calcutta for export; and since 1913 they have resolutely maintained the prohibition of export of opium to China. One of the provisions of the Hague Convention of 1912, *viz.*, that raw opium shall not be exported to countries that prohibit its import, has always been strictly observed by the Government of India, and since 1915 it has also been their policy to enter into direct sale agreements with the Governments of the imposing countries who are responsible (as signatories to the Hague Convention) for limiting imports to 'legitimate' requirements and for preventing export. With effect from January 1923, the 'Import Certificate System' prescribed by the League of Nations, has also been adopted. In 1926, the

Government of India initiated a new export policy. With effect from April 7th 1926, the public auctions at Calcutta have been discontinued, and from that date no opium can be exported to the Far East except under a direct agreement with the Government of the importing country. Further, the Government has decided to abolish exports to the Far East in 10 years, that is, no opium will be exported for purposes other than medical and scientific after December 31st, 1935.

As regards the consumption of opium in India for euphoric purposes, there is no doubt that opium is habitually taken by certain sections of the population. It is consumed in the form of a pill or in solution in water. Opium smoking, except in Assam and Central Provinces, is a very uncommon method of indulgence nowadays. The opium habit, however, is not nearly so common in India at the present time as might be imagined from some recent publications on the subject. The habit is not widely disseminated among the populations, and although there are admittedly certain areas and certain classes of populations which are badly affected, these constitute a small minority. There is evidence to show that in most parts of India the consumption is well below the standard laid down by the League of Nations as being necessary for purely medical and scientific needs of the population. Here and there in every province there are areas where consumption of opium is very high. Those zones are being carefully investigated by the Local Governments concerned to determine the causes which have led to increased consumption of opium with a view to their eradication. The habit is not spreading, and in fact during the last twenty years it has shown a remarkable decrease all over the country. This is shown by the following figures giving the quantity of excise opium issued for consumption in British India including Burma :—

1911-12	1,031,227 lbs.
1919-20	885,721 ,,
1925-26	600,784 ,,

The decrease has been more marked lately and the work of the author shows that the factors which have been instrumental in reducing consumption are decrease in its production

and increase in its price For further information on the subject of opium habit and its effects the reader is referred to the original papers written by the author and his co-workers.

Effects of Opium on Blood-sugar and Albuminuria:—The effects of opium on blood-sugar of diabetics and non-diabetics have been worked out by Chopra and Bose (1931) in view of the popular belief that this drug has got beneficial effects in glycosuria. It has been shown that small and moderately large doses of opium have little or no effect on the blood-sugar. Another popular belief among the medical profession is that patients suffering from kidney diseases stand opium badly. The same workers have shown that opium in doses ranging from 1 to 9 grains daily in patients suffering from albuminuria has no deleterious effect on the quantity of albumin excreted; in fact in many cases there is an appreciable decrease.

Psychological Effects of Opium Addiction:—Chopra and Bose (1931) have carefully studied the psychological aspects of opium addiction on a series of patients in the hospital. These workers have shown that in the withdrawal or abstinence symptoms, there is a predominant psychic element which can be overcome if the circumstances demand it. This is amply shown by experience with convicts in jails, and in men under war conditions, who have to give up opium suddenly and yet suffer no marked discomfort or withdrawal symptoms. During the treatment of addicts to rid them of the opium habit, opium can be largely or totally replaced by substances like gentian or nux vomica preparations in pill form without trouble. The series of cases studied by these workers show that if the patient is not aware that he is taking opium, the drug can be effectively given for weeks and months for its therapeutic effects and can be stopped at any moment without producing abstinence symptoms. Physicians, therefore, need not hesitate to use opiates in special cases where these are indicated, provided the identity of the drug is concealed from the patient. The author regularly uses opiates in this manner in the treatment of asthma, amœbiasis or any other conditions which are likely to be benefited without producing a habit. Opium given in this manner, can also be effectively used to detect malingering.

NARCOTINE :—*Narcotine* is one of the alkaloids occurring in opium which, so far as its quantity is concerned, comes next to morphine in importance. In many varieties of opium it is quite half as abundant. Although it was isolated about the same time as morphine, it does not appear to have received much attention at the hands of the early workers possibly because of its less powerful action. It was considered by its discoverer Derosne to be the active principle of opium and this fact accounts for its name *narcotine*. Later it was suggested that *anarcotine* would be a more fitting name because it lacked narcotic effects. It would appear that the older writers had appreciated the absence of any marked narcotic properties in this alkaloid as, except for occasional reference to its use in the treatment of migraine as an analgesic, it has not figured anywhere in therapeutics for its action on the central nervous system. The only other use made of it in medicine was in the treatment of malaria.

Chemistry and Physical Properties :—Narcotine, $C_{22}H_{23}O_7N$, exists in the plant in a free state. It has been found to occur in the dried poppy capsules in fairly large quantities. An analysis of unlanced poppy heads carried out at the Calcutta School of Tropical Medicine and Hygiene showed that it constituted about 30 per cent. of the total alkaloidal yield. It usually occurs to the extent of 5 to 6 per cent. in Asia Minor opium, but in Indian and Persian opium it is present to the extent of 10 to 12 per cent. A perusal of the following table will show that in Patna or Behar opium the narcotine content is nearly double that of the morphine content; in Malwa opium narcotine is slightly larger in quantity than morphine; in Smyrna opium narcotine occurs in much smaller quantities, less than ¼ of the morphine content.

Description of Opium	Morphine per cent.	Narcotine per cent.
Patna Opium (Behar Provision cake) ...	3.98	6.36
Malwa Opium	4.61	5.14
Smyrna Opium	8.27	1.94

Narcotine is present in opium in a free state though some authorities think it occurs in the form of a meconate. It can be readily separated from the other alkaloids.

When opium is extracted with water, morphine goes into solution, but the greater part of narcotine remains undissolved. By exhausting the residue with dilute hydrochloric acid the alkaloid is removed as a hydrochloride; from the solution of this salt the base may be precipitated by sodium bicarbonate and crystallised from alcohol. Narcotine may also be extracted from opium by boiling it with ether.

Narcotine occurs as odourless, tasteless, shining prismatic crystals, having a melting point 176°C. The base is very slightly soluble in water, 1 in 25,000 at 15°C and 1 in 7,000 at 100°C. It is soluble in alcohol, ether and in benzene; very soluble in chloroform; slightly soluble in amyl alcohol or light petroleum.

Pharmacological Action :—Narcotine is an important subsidiary alkaloid of opium inasmuch as it constitutes on an average 5 to 6 per cent. of opium. It occurs in large quantities as a bye-product in the manufacture of morphine and codeine and so far little or no use has been made of it in medicine. The alkaloid is readily absorbed from the site of injection; it does not produce much local irritation or necrosis of the tissues. Narcotine definitely inhibits the peristaltic movements of the gut. It relaxes the tone of the involuntary muscle tissue all over the body, *e.g.*, of uterus, bladder, gall bladder, etc., by its direct action on the muscle fibres.

Given intravenously in animals, narcotine produces a fall of systemic blood pressure followed by a slight rise. The fall is due to dilatation of the blood vessels, especially those of the splanchnic area, by its direct action on the musculature of the vessel wall. The subsequent rise is probably due to reflex stimulation of the vasomotor centre to counteract the fall in systemic pressure. The stimulation of the auricle and ventricle seen in myocardiograph experiments cannot be wholly explained by vasomotor stimulation, and there is evidence to show that the sympathetic ganglion cells of the cardiac plexuses may be excited. The depression of the heart seen in perfusion experiments is more than compensated by these two factors. Narcotine, unlike morphine, stimulates the respiratory centre in the medulla. The plain muscle of the bronchioles is relaxed. The drug, in the animals at any rate, has a stronger action on the cord than on the brain. The marked depressant effects of narcotine on the central nervous system found by some of the early workers can be accounted for by the presence of other alkaloids of opium as impurities, due to imperfect technique. Narcotine has been shown to have a depressant action on the algesic areas in the brain and, therefore, lessens such symptoms, as headache, pain in the limbs, discomfort, etc., attendant on febrile conditions. It undoubtedly enhances the action of morphine and codeine so that much smaller quantities of these alkaloids would be effective if given in combination with narcotine. The voluntary muscles are not affected. The secretions do not appear to be greatly influenced by narcotine in therapeutic doses. In toxic doses there is a marked stimulation of

salivary secretion, but urine, sweat, etc., are hardly touched. Narcotine is not a very toxic alkaloid; its minimum lethal dose is 2 mg. per gramme body weight in frogs and 1.5 to 2.0 gm. per kilo body weight in cats. Large doses such as 1 or 2 gm. can be given in man without producing any marked toxic effects.

Therapeutic Uses :—In the report of the Opium Commission of 1895, it was stated that the habit of taking opium prevails in excess among the population of low-lying, damp and malarious districts of India, and it was implied that this drug has an anti-malarial action. Dr. Roberts in his note said that the belief in the usefulness of opium in the complaints of damp and malarious districts was very widely spread. According to him the consumption of opium in the marshy districts of England was very large in the days when lands were undrained and malaria was prevalent. The evidence laid before the Opium Commission showed that in some districts of India the local consumption of opium bore a close relationship to the greater or less prevalence of malaria in these localities. In determining the question from a scientific point of view as to what extent opium has the power to cure and prevent genuine malarial fever, Dr. Roberts pointed out that the two important and abundant alkaloids occurring in opium are morphine and narcotine or anarcotine. Morphine represents the anodyne and hypnotic properties of the drug and narcotine is a bitter crystalline alkaloid resembling quinine and like that substance possesses tonic and anti-periodic properties.

Opium in Malaria :—So far as the action of opium in malaria is concerned, it has been shown by the author (1928) that this drug is not much used at the present time, as a household remedy for its supposed prophylactic or curative effects. In some of the low-lying districts of the Punjab along the course of such rivers as the Jhelum, the Chenab and the Indus, the climate is very damp and a virulent type of malaria prevails. The spleen index in these areas is also very high but the consumption of opium is very small indeed, while in some of the comparatively dry and healthier areas the consumption is enormous. Careful inquiries in these areas do not show the existence of any belief among the rural or urban population in the anti-malarial properties of opium in combating an attack or in preventing recurrences. There is no doubt that the main factor responsible for the extent to which the drug was used was the availability of opium in a particular locality. When opium was grown in these very areas, its consumption was much greater than it is at the present time.

Opium on account of its sedative effects undoubtedly ameliorates the symptoms produced by malaria, but it has no curative action whatsoever in this disease. Our everyday experience among opium addicts in the central districts of the Punjab convinced us that they suffered just as much from malaria as those who were not addicted to the drug, during the seasons when this disease was prevalent. Opium has neither a prophylactic nor a curative action in the disease.

Narcotine in Malaria.—As regards the suggestion made by Dr. Roberts that narcotine may possibly be the alkaloid which has anti-malarial properties, this belief appears to have been based on two communications. The first one was from Dr. Palmer (1857-59) who at Ghazipur treated 546 cases of malaria with narcotine, in doses ranging from 1 to 3 grains. Of these 541 are said to have been cured and 5 died. In addition to these he tried the alkaloid in a large number of other cases. He summed up his experiences by saying that in 70 per cent. of cases the fever was permanently arrested at the second paroxysm after narcotine was administered, in 20 per cent. the arrest was equally sure, but was not quite so quick and in 10 per cent. the medicine did not appear to have any curative results. Dr. Palmer further remarked that there are cases where narcotine is decidedly more efficacious than quinine, namely, where there is an intolerance of quinine and where quinine has been given without any effect for a long time. The second communication is a report by Dr. Gordon which was published in the seventh volume of the *Indian Annals of Medical Science*. This worker treated altogether 684 cases of malaria with narcotine and gave details of 194 cases. According to him 187 were rapidly cured and only in 7 cases the alkaloid failed to produce any effect. Moreover, he asserted that narcotine cured some cases in whom quinine had failed. The dose employed by this author ranged from 1½ to 3 grains and he expressed the view that narcotine is not of equal value to quinine but has a claim to the next place in the ranks of anti-periodics. After this work narcotine continued to be in large demand and was regularly supplied from the Government factories until 15 or 20 years ago when quinine became cheaper and more abundant. It is worthy of note here that 1 to 3 grains of narcotine, which according to Drs. Palmer and Gordon cut short the paroxysms of malarial fever and completely arrested the disease, would be contained in 16 to 48 grains of Behar opium which contains 6.36 per cent. of narcotine. This will mean that only large consumers of opium would be protected against malarial fever if any protective action existed. Such large doses of opium are rarely taken nowadays.

As the effect produced by narcotine in malarial fever still remained undecided, the author tried the action of this

alkaloid in a series of cases with a view to determining if it really produced any effect on the malarial parasites or on the clinical symptoms occurring in the disease. The patients were all admitted into the Carmichael Hospital for Tropical Diseases. Not only was the peripheral blood examined daily, merely to detect the presence of malarial parasites, but daily counts of the parasites were made in order to see if their number was adversely affected by the drug. Cultures were also taken in most of these cases before and after the treatment had been given. In every case the parasites were viable and grew well even after large doses of the alkaloid had been administered showing that narcotine had not injured them in the slightest degree. The alkaloid narcotine even in such large doses as 10 to 15 grains daily has no effect on the parasites of any forms of malaria circulating in the peripheral blood. The temperature of the patient remains unaffected and rigors and paroxysms continue.

The author has tried narcotine in a number of patients suffering from malaria, diabetes, pneumonia, etc., in doses varying from 5 to 20 grains daily. None of these patients showed any marked depression of the higher faculties as occurs with morphine, nor were there any signs of stimulation of the psychical areas of the brain. The algesic areas, however, appeared to be somewhat depressed and sensibility of the patient to pain and discomfort produced by disease was decidedly diminished. The patients looked more comfortable after the alkaloid was administered and felt better although the temperature was not appreciably affected. There was no very marked stimulation of the respiration and the heart, and no heightening of the reflexes, so that in therapeutic doses in man at any rate there were no outward signs of hyperexcitability of the medulla or the spinal cord.

When taken by the mouth in doses of 0.4 gm. (6 grains) and 0.6 gm. (10 grains) the alkaloid produces a nauseating feeling which increased on moving the head. There was a distinct sensation of well-being for about an hour after the drug was taken. No other action on the central nervous system was observed. In another individual 8 grains were given after a hard day's work. The sensation of fatigue greatly disappeared and this was followed by a feeling of lassitude and inclination to lie down if not to sleep. No other effects were observed.

Economic Aspects :—A perusal of what has been said will show that narcotine occurs in large quantities in the Indian opium and that if it could be utilised in therapeutics, it would be available at a very cheap price. Large quantities of this alkaloid have accumulated in the Opium Factory at Ghazipur since its use was abandoned in the treatment of malaria. As the alkaloid itself does not appear to have any potent therapeutic properties, attempts have been made to prepare derivatives from it which might be physiologically more active. One of these products is *Cotarnine hydrochloride* (*Stypticin*). Cotarnine hydrochloride was placed on the market many years ago, and it is said to be useful in all forms of uterine hæmorrhages and also for checking profuse menstruation ; 1 to 2 per cent. may be used as a tampon. It is also used in the form of a 5 per cent. ointment in the treatment of erysipelas, eczema and shingles. Tablets of cotarnine hydrochloride containing $\frac{3}{4}$ grain are on the market and stypticin wool and gauze (30 per cent.) are also prepared. A preparation cotarnine phthalate under the trade name of 'styptol' is also on the market and is administered in 5 grain doses in similar troubles. 2 : 4 dihydroxyphenyl cotarnine hydrochloride has also been prepared and is said to have a quinine-like action.

The alkaloids of opium are more or less narcotic and convulsant in their action, but as the latter group occur in small quantities, their action is dominated by the former group. The exact difference between the action of morphine, opium and combinations of other alkaloids introduced in therapeutics under the names of 'pantopon', 'narcophine', etc., have not been worked out. It is, however, well-known that narcotine which is not a very active alkaloid increases the toxicity of morphine and codeine. Older investigators have shown that a dose of opium acts more strongly on the frog than the corresponding quantity of morphine contained in it. Small doses of morphine, in themselves inactive, produce when combined with small quantities of the subsidiary alkaloids, severe symptoms of poisoning (Gottlieb and Eeckhout, 1908).

Winternitz (1912) showed that hypnotic and sedative effects were produced in man by alkaloids of opium from which

morphine had been completely eliminated. The only alkaloid barring morphine that has a sedative effect in man is codeine which when given by itself has a feeble action. In combination with the other alkaloids of opium, however, codeine produces as strong an effect as morphine. The other alkaloids, therefore, appear to potentiate the action of codeine and of these narcotine has been shown to be the most important synergist. Narcotine also has a well-marked synergistic action when combined with morphine so far as its action on the central nervous system is concerned. Levy (1916) found that 3 mgm. of an equal mixture of morphine and narcotine exerted as great a narcotic action as 10 mgm. of morphine. The greatest increase in activity is obtained when equal parts of narcotine and morphine are given together. The decrease in perception of pain in man is also more marked when morphine and narcotine are combined. The combination of one molecule of each with meconic acid has been recommended by Straub (1912) and named 'narcophine' for use as a general analgesic. Interesting experiments were conducted by Macht, Johnson and Bollinger (1916) and Macht, Herman and Levy (1918) to show that the increase in the pain-depressing action is due to the subsidiary alkaloids especially narcotine. By measuring the strength of the induced current which would just produce a pain sensation from a single sensation point, they showed that 'pantopon' and 'narcophine' increase the threshold value of the effective stimulus more than the corresponding amount of morphine. These observations have been confirmed and open a wide field for the use of narcotine.

We have already referred to the depressing effect of narcotine on the algesic areas in the brain, and from experience with this alkaloid we can fully corroborate the synergism which exists between narcotine and morphine, and narcotine and codeine. Narcotine also possesses an antagonistic action to the depressing effect produced by morphine on the respiratory centre. It appears therefore that, although narcotine by itself is not a therapeutically very active drug, it has got great possibilities of being a useful therapeutic agent by combination with other

opium alkaloids in suitable proportions which have yet to be worked out.

References :—

(1) *Report of the Opium Commission*, 1892-93; (2) Chopra, R. N., and Grewal, K. S., 1927, *Ind. Jour. Med. Res.*, Vol. XV, July; (3) Chopra, R. N., 1928, *Ind. Jour. Med. Res.*, Vol. XVI, October; (4) Chopra, R. N., 1930, *Ind. Med. Gaz.*, Vol. LXV, July; (5) Chopra, R. N., Grewal, Chowhan, and Chopra, 1930, *Ind. Jour. Med. Res.*, Vol. XVII, April; (6) Chopra, R. N., and Knowles, R., 1930, *Ind. Jour. Med. Res.*, Vol. XVIII, July; (7) Chopra, R. N., Mukherjee, B., and Dikshit, B. B., 1930, *Ind. Jour. Med. Res.*, Vol. XVIII, July; (8) Chopra, R. N., and Bose, J. P., 1930, *Ind. Jour. Med. Res.*, Vol. XVIII, July; (9) Chopra, R. N., and Bose, J. P., 1931, *Ind. Jour. Med. Res.*, *Vol. XVIII, April*; (10) Chopra, R. N., and Bose, J. P., 1931, *Ind. Med. Gaz.*, Vol. LXVI, June; (11) Chopra, R. N., Bose, J. P. and De, N., 1931, *Ind. Med. Gaz.*, Vol. LXVI, November; (12) Chopra, R. N., and Bose, J. P., 1931, *Ind. Med. Gaz.*, Vol. LXVI, December.

PEUCEDANUM GRAVEOLENS (N.O. Umbelliferæ)

The Dill

VERN.—Sans.—*Misreyá, Satapushpi* ; Hind.—*Sowa, Soya* ; Beng.—*Súlpha* ; Kashmir—*Soi* ; Bomb.— *Baluntshep* ; Tam.—*Sala kuppi* ; Arab.—*Shubit.*

The properties of dill oil, dill water and the other preparations in which the fruit of this plant is administered, are too well-known to require a detailed description. Apart from its medical use it is in a great demand as a condiment, and the oil derived from it is largely used in the manufacture of soap. *P. graveolens* is indigenous to Central and Southern Europe and the tropical and subtropical countries and it is also cultivated in various parts of the globe. In India, it is cultivated as a cold-weather crop and yields a fruit which is much more narrowly winged than the variety met with in Europe. It is, therefore, considered by some to belong to a distinct species *Anethum sowa*, (Roxb.) or *Peucedanum sowa*, (Kurz.). The essential oils derived from Indian and foreign fruits also differ in composition. The Indian oil shows a

higher specific gravity, lower rotation and a constituent with a high boiling point. This will be evident from a study of the physical properties of the different oils given in table below. (Modified from Umney's table).

	Sp. gr.	Optical rotation	Boiling Point Below 200°C.	Above 230°C.
English Oil (I) ...	0.9148	+72.25°	22	2
English Oil (II) ...	0.9146	+80.25°	21	2
German ...	0.9002	+70.25°	53	5
Indian ...	0.9486	+47.5°	24	39

The total yield of the oil from the East Indian fruit is practically the same as that obtained from other sources. Thus the English fruit yields about 4.0 per cent., German 3.8 per cent. and the East Indian about 3.19 per cent. of oil. The chief constituents are carvone, phellandrene and d-limonene. In contradistinction to other dill oils, the Indian oil is obtained in two different fractions—a fraction with a low specific gravity known as the 'light oil' and another with a high specific gravity known as the 'heavy oil'. An analysis of the Indian oil by Ciamician and Silber (1896) showed that this oil contains, over and above the usual constituents, an apiol which is rather peculiar in its properties and has been termed 'dill apiol'. Genuine dill oil contains no constituent boiling at so high a temperature as 285° and no portion of the distillate sinks in water. On account of these differences, the oil obtained from the dill fruit growing in India has not been accepted officially. Recently, some experiments were conducted with samples of Baroda oil from which the dill apiol has been removed by distillation. This oil (without dill apiol) is said to correspond very closely to the official standards and might probably be used as a substitute. Further experiments are however necessary to confirm the truth of these observations.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Rao, Sudborough and Watson, 1925, *Journal of Ind. Inst. of Science,* Vol. 8A, p. 183;

(3) *Pharmaceutical Journal*, 1898, Vol. 7, p. 176; (4) Ciamician and Silber, 1896, Ber., Vol. 29, p. 1799.

PICRASMA QUASSIOIDES (N.O. Simarubeæ)

VERN.—Hind.—*Bharangi*; Beng.—*Bhurungi*; Punj.—*Khashbar*.

This is a small tree or a large bush generally found in the subtropical Himalayas and Kashmir. The bark and the leaves are used in the Punjab as a febrifuge and as an insecticide. The general structure of the wood as well as the taste of *Picrasma quassioides* closely resemble that of *Picræna* or *Picrasma excelsa* of the British Pharmacopœia and it has been recommended as a substitute for it. Recent researches carried out at the Calcutta School of Tropical Medicine show that *Picrasma quassioides* contains a bitter principle *quassiin* which is almost identical with the *picrasmin* of the official *Picrasma excelsa*. An allied species, *P. nepalensis*, was also examined but was found to be inactive.

So far no standard chemical methods for the isolation of the active principles of this drug have been worked out. Quassiin, a crystallisable bitter substance obtainable from the drug, is supposed to be the active principle but there are other bitters associated with it. As there is no accurate method of estimation of quassiin, it is difficult to assess the value of the Indian drug in terms of the drug in use in the B.P. Following the method suggested for the isolation of the active principles of *P. excelsa* in the British Pharmacopœia, the results obtained were as follows:—

	P. quassioides	*P. excelsa*
Aqueous extract	8.36 per cent.	5 04 per cent.
Alcoholic extract ...	5.78 ,, ,,	3 25 ,, ,,
Bitter principles .	0 31 ,, ,,	0.48 ,, ,,

The bitter principle was obtained by repeated treatment of the alcoholic extract with hot water, neutralising, concentrating the solution and finally precipitating with tannic acid. The precipitate thus produced was decomposed with freshly precipitated lead hydroxide, evaporated to dryness and extracted with absolute alcohol. The alcoholic solution was evaporated on a water bath and the residue then weighed. White needle-shaped crystals were obtained mixed with other extractives and the residue was extremely bitter.

The quantity of crystals which appeared in the case of *P. excelsa* was somewhat in excess of those derived from *P. quassioides*. Besides these, the latter contains a bitter alkaloid to the extent of about 0.05 per cent. and another fluorescing bitter substance soluble in chloroform amounting to 0.15 per cent. These act as adjuvants to quassiin and enhance the action of the drug.

Quassia is a popular bitter and is largely used in the Western medicine. In the indigenous medicine, like many other bitter drugs, it is used as a febrifuge and as an antimalarial remedy. Though the official source, *Picrasma excelsa*, is not available in India, *Picrasma quassioides* is obtainable in large quantities. Apart from its natural habitat in the Himalayas, it has quite recently been found by the Botanical Survey Department to be growing profusely at Mao, on the border line of the Manipur and Naga Hills (Assam) at an altitude of 6,000 ft. The hills are accessible and transport facilities for the crude drug are said to be quite good. In view of this new source of the drug and judging from the results of analyses so far conducted, *Picrasma quassioides* should be able to completely replace the official drug. Indian quassia unfortunately has not yet become a marketable commodity owing to there being little or no demand ; it will be worth while for the Indian manufacturers to try it.

References :—

(1) Chopra, Ghosh and Ratnagiriswaran, 1929, *Ind. Jour. Med. Res.*, Vol. XVI, p. 770; (2) *British Pharmaceutical Codex*, 1923.

PIMPINELLA ANISUM (N.O. Umbelliferæ)

The Anise

VERN.—Sans.—*Shetpushpa* ; Hind.—*Saurif, Saonf* ; Beng.—*Muhúri* ; *Mithájirá* ; Bomb.—*Sonf*. Tam.—*Shombu*.

Pimpinella anisum is an annual herb found originally in Egypt and the Levant but is now cultivated on the Continent of Europe, chiefly in Russia and also in Spain, Holland, Bulgaria, France, Turkey, Cyprus and many other places. In Russia,

a great deal of attention is paid to its cultivation and it is understood that the cultivation is gradually extending from the district of Valuiki to several other districts. The fruits as well as the essential oil distilled from them form a good source of revenue to the Russian producers. In Cyprus also, a good deal of anise is produced. In India, anise is found in various parts of the United Provinces and the Punjab and to a smaller extent in Orissa. It is not a true native of the Indian soil but is supposed to have been introduced by the Mohammedan invaders from Persia. It is, however, completely naturalised in India at present. The fruits yield on distillation a volatile oil (oleum anisi), which is used both in the indigenous and the Western medicine to prevent flatulence and intestinal colic. In the Tibbi or Mohammedan medicine, Anise water or 'Arak badian' is largely used. It is also much appreciated for its aroma in toilet soaps and dentifrices and consequently has a great commercial value. India's quota in the anise trade is very meagre but the reasons for this are not clear. The anise herbs cultivated in India yield the same constituents on distillation as the other varieties and are in no way inferior. Most of the oil of commerce, however, is derived nowadays from *Illicium verum* (the star anise), N.O. *Magnoliaceæ* which is indigenous to Southern China and Tongking and is also extensively cultivated in those parts. This is a much more hardy crop, grows more plentifully than the true anise and is available at a much cheaper price than the true anise. The two oils are practically identical except that the true anise oil has a more delicate odour and flavour than the star aniseed oil. The characters are given below. The content of anethole which is supposed to be the chief constituent is practically the same.

	True Anise Oil (*Pimpinella anisum*)	Star Anise Oil (*Illicium verum*)
Sp. gr. at 20°C ...	0.975 to 0.990	0.980 to 0.990
Optical rotation ...	0 to −2°	0 to −2°
Refractive index ...	1.552 to 1.558	1.5530 to 1.5565
Congealing point ...	+15° to +19°	+15° to +17°
Melting point	16° to 19°	16.5° to 19°

Both these oils have been made official and, therefore, may be used freely in medicine. In commerce also, star anise has been used for some years, as the sole raw material for the manufacture of anethole or anise camphor. These facts have greatly discouraged even the Russian producers of true anise and the cultivation is said to be rapidly declining. It does not seem likely that India would gain much by cultivating this plant on a large scale. Star anise of the particular species which yield the oil of commerce is not available in India. A variety known as *Illicium griffithii* is found but this is useless from the point of view of oil production.

References :—

(1) Finnemore, 1926, *The Essential Oils*; (2) Schimmel & Co., 1928, *The Report*; (3) Parry, 1924, *The Chemistry of Essential Oils and Artificial Perfumes.*

PINUS LONGIFOLIA (N.O. Coniferæ)

Chir Pine

VERN.—Sans.—*Sarala* ; Hind.—*Saral, Chir, Chil.*

Turpentine is obtained by steam distillation of the oleo-resin which exudes when the sapwood of various coniferous trees is injured; the flow of sap is produced as a protection to injured parts. The name is sometimes applied, in a broader sense, to include oil obtained by dry distillation or in other ways from pine saw-dust or pine wood. This oleo-resin yields about 20 per cent. of oil of turpentine and about 80 per cent. of residue which is very largely used under the name of 'colophony' or resin.

The rectified oil, oleum terebinthinæ rectificatum, is used very commonly in medicine but the demand for it is not very large. In the field of industry, however, turpentine is used to an enormous extent. It is largely used in the perfume industry and in the manufacture of artificial camphor. The

largest amount is consumed in the manufacture of paints and varnishes. A considerable quantity of the resin is also used for the adulteration of shellac, in the preparation of varnishes, in the manufacture of paper, in soap factories, etc.

The conifers are widely distributed in all parts of the world, those growing in the temperate and tropical regions yield the best resin, while those of colder climates give a smaller yield and have a shorter producing season. The United States of America possesses vast forests of pine on the coasts of the Atlantic and the Gulf of Mexico, amounting to about 10 million acres. Huge quantities of turpentine are produced there and it has been estimated that nearly 67 per cent. of the world production is derived from there. The pine forests are very systematically worked in that country and all methods of wasteful exploitation are forbidden by the State laws in order to prevent exhaustion of the supplies. *Pinus palustris* (the long-leaf pine) is the chief variety of tree tapped for the oleo-resin but *P. heterophylla* (slash pine), *P. echinata* (short-leaf pine), *P. tæda* (the Loblolly pine), *P. serotina*, etc., are also utilised whenever possible. That enormous quantities of turpentine oil are produced will be seen from the fact that in 1925-26, 480,000 barrels of 50 gallons each and 1,599,000 barrels of 5,000 lbs. each of resin were released from the factories. France occupies the next position in the world trade on turpentine products and commands nearly 22 per cent. of the world production. It is interesting to note that this huge industry has been developed only within the last century. The centre of the industry is at Bordeaux and it occupies a triangular region called the 'Landes' whose base extends for 40 miles along the coast adjoining the Atlantic Ocean. 'Landes' was formerly a waste, sandy desert submerged in winter and dried up in summer, entirely worthless and unfertile. Cultivation of pine was started at the beginning of the nineteenth century and the soil was reclaimed and gradually improved between 1803-1864 by the erection of artificial dams, proper drainage and cultivation of sand-binding grass. To-day, France has in the 'Landes' more than a million hectares of pine forests chiefly consisting of *Pinus*

maritima and *P. sylvestris*, producing turpentine oil and colophony in enormous amounts. There are nearly 180 turpentine factories scattered throughout the 'turpentine district' and in 1926 turpentine oil valued at 7,681,000 francs was exported. Spain, Portugal and Greece also possess flourishing industries in turpentine oil and its products.

India is very rich in her pine resources. Five species of pine are found in India of which 3 may be regarded as important from the point of view of turpentine production. These are *P. longifolia*, *P. excelsa* and *P. khasya*. *P. excelsa* (the Kail or blue pine) occurs in the temperate Himalayas and occupies about 60,000 acres in the United Provinces and in the Punjab. The trees are somewhat inaccessible and it is doubtful if commercial distillation will be possible as the yield of oleo-resin is rather low and cheaper transport facilities are not available at present. *P. khasya* (the Dingsa or Khasia pine) occurs in the Khasia Hills, the Lushai Hills, the Chittagong hill tracts, in the Shan Hills and in hills of Martaban in Burma. Indian turpentine available in the market is produced chiefly from *Pinus longifolia*, Roxb., (the 'Chir' pine), one of the most important trees of India. Extensive pine forests are distributed on the slopes of the Himalayas at elevations of 2,000 to 6,000 feet in the mountainous regions from Afghanistan through Kashmir, the Punjab and the United Provinces to Bhutan, Assam and Upper and Lower Burma, amounting to over two million acres. These are distributed roughly as follows:—United Provinces—1,000,000 acres, the Punjab—270,000 acres, Kashmir—692,000 acres and North-Western Frontier Provinces—23,000 acres.

Economic Aspects:—The economic possibilities offered by these pine forests need no emphasis. Attention was directed towards the working of the 'Chir' pine for resin nearly 40 years ago. The original experiment was conducted under the auspices of the Forest Department and as soon as it was proved that the turpentine and resin from the Kumaon forests were readily saleable, systematic operations began in the Nainital Forest Division with 10,000 trees and a distillery was erected at Bhowali on a site 5,500 ft. above the sea level with excel-

lent facilities for water supply. Later, a factory was opened at Jallo and since 1914 turpentine and resin have been produced here on a large scale. In 1925 the quantities sold amounted to about 147,000 gallons of turpentine oil and 45,000 maunds of colophony. A new distillery fitted with modern equipment was started at Chitterbuckganj near Bareilly in 1920 and is also turning out the pine products on a large scale. Tapping for the oleo-resin is now carried on in West Almora, East Almora and Nainital in the United Provinces and in certain places in the Punjab, but the vast natural resources have not yet been thoroughly and satisfactorily exploited. All the pine forest reserves cannot be profitably worked for production on account of the distance of these forests from the railway and the consequent increase in the cost of transport. In spite of this disadvantage the production of Indian turpentine is rapidly increasing. In 1913-14 turpentine valued at £28,319 and resin valued at £33,150 were imported into India. In 1917-18 according to reports of the Overseas Trade Department, 276,000 gallons of turpentine were used in India, of which 140,772 gallons were imported and 136,052 were actually manufactured in the country. It was also estimated that in ten years from that date the output of Indian turpentine will be increased to something like 300,000 maunds of resin and 800,000 gallons of turpentine. The expectation with regard to the increased yield of turpentine has been fulfilled. India has now practically become self-supporting and is even contemplating export of the products to other markets. There are, however, difficulties to be faced. American and French turpentines are mostly composed of 'terpenes', chiefly the 'pinenes', but the Indian turpentine consists mainly of two other hydrocarbons 'carene' and 'longifolene'. The Indian turpentine, on account of the absence of pinene, cannot be employed in the camphor industry. It also undergoes easy oxidation and leaves a high percentage of resin on evaporation and hence is considered to be inferior to the other products. But Indian turpentine can be used in many industries in place of the American or the French though the composition varies to a certain extent.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Gibson and Mason, 1927, *Indian Forester*, Vol. 53, p. 379; (3) Fowler, G., 1928, *Capital*, Dec. 13; (4) Schimmel & Co., 1928, *Report;* (5) Simonsen, J. L., 1920, *J. C. S. Trans.*, p. 570; (6) Simonsen and Pillay, 1928, *J. C. S. Trans.*, p. 359.

PIPER CUBEBA (N.O. Piperaceæ)

Cubebs

VERN.—Sans.—*Sugandhamuricha ;* Hind., Beng. & Bomb.—*Kabab-chini ;* Tam.—*Val-milaku ;* Tel.—*Chalavamiriyalu ;* Pers. & Arab.—*Kibabeh.*

This is a climbing, woody bush indigenous to Java, Sumatra and the Malay Archipelago and is cultivated to a small extent in India. The fruit commonly known as cubebs has been extensively used as a condiment, particularly in the tropics. Old Arabian and Persian physicians are said to have used the fruit in genito-urinary diseases. Its use in the Western medicine can be traced to the middle ages. The English name is probably derived from the Arabic 'Kibabeh'. The fruit owes its activity to the presence of an essential oil which occurs to the extent of 10 to 15 per cent. This oil has a pleasant characteristic odour and a greenish to greenish-blue colour and is used, though to a small extent, in genito-urinary diseases like cystitis, gonorrhœa and gleet.

The chemistry of the oil of cubeb has not been very thoroughly worked out but the following constants are known :—Specific gravity 0.910 to 0.930; optical rotation −25° to −40°; refractive index 1.486 to 1.500. The solubility in alcohol also varies but most samples require as much as 10 volumes of 90 per cent. alcohol.

Though not indigenous to the Indian soil, *Piper cubeba* has been grown in the Mysore State. Rao, Sudborough and Watson (1925) have studied the oil distilled from cubebs experimentally grown there. They were able to obtain 11.85 per cent. of the oil with the following constants :—Specific gravity 0.9167, optical rotation −29.9°; refractive index 1.4894; saponification value 0.5 and saponification value after acetylation 24.1.

Indian Cubeb oil (Fractionated at 685 mm. pressure)		B. P. Cubeb oil	
Temperature in degrees centigrade	Per cent.	Temperature in degrees centigrade	Per cent.
Between 140 to 170 ...	5	Below 200	5
,, 170 to 225 ..	20	Between 200 to 230 ...	11
,, 225 to 245 ...	15	,, 230 to 240 ..	8
,, 245 to 265 ...	45	,, 240 to 250 .	15
,, 265 to 280 ..	10	,, 250 to 255 .	31
Residue and loss ...	5	,, 255 to 257 ..	25

It will appear from a study of the table that in the case of genuine oil 56 per cent. distils over between the temperatures 250° to 280°, whereas in the case of the Indian oil 55 per cent. distils over within practically the same range of temperature. The difference, therefore, between the two specimens is negligible and it appears to be probable that the Indian oil is in no way inferior in medicinal properties to the oil of commerce. If cubebs are grown more abundantly, there is a reasonable possibility of the production of this oil for medicinal and other purposes.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Rao, Sudborough and Watson, 1925, *Jour. Ind. Inst. Sci.,* Vol. 8A, p. 139; (3) Unney and Potter, 1912, *Perfumery and Essential Oil Records,* Vol. 3, p. 64.

PODOPHYLLUM EMODI (N.O. Berberideæ)

Indian Podophyllum

VERN.—Hind.—*Papra, Papri, Bhavan-bakra, Bakra-chimyaka ;* Punj.—*Ban-kakri, Gul-kakru.*

Podophyllum emodi is a small herbaceous plant met with in the higher shady temperate forests of the Himalayas

from Sikkim to Kashmir at a height of 7,000 feet above the sea level. In Kashmir, it occurs at an altitude of 6,000 feet and chiefly abounds on the northern slopes of the mountains where the sun does not shine so strongly. It is also plentiful on the northern forest-clad slopes of the Shalai Hills, east of Simla. In the higher ranges of Kangra, Kulu and Chamba there are many rich forests whose glades are almost exclusively covered with this herb and large quantities are collected for sale. The plant attracted the attention of the ancient Hindu physicians and in the indigenous medicine the names 'papra' or 'nirbash' and 'bhavan-bakra' given to it show that its bile-expelling properties were fully known to them.

Podophyllum resin is used in medicine as a drastic purgative and as a cholagogue. The resin is derived from the rhizomes of *Podophyllum peltatum* (May apple or mandrake, N.O. *Berberideæ*) which is official both in the British and the United States Pharmacopœias. It grows plentifully in America. About 35 years ago, American podophyllum rhizome and the resin 'podophyllin', had a very wide sale in England and on the Continent. The resin was also imported into India during that period as the composition and properties of the Indian variety, *Podophyllum emodi,* were not fully recognised. Watt, many years ago, carried out investigations regarding its claims as a substitute for the official drug and found that Indian podophyllum contained about 3 times the resin present in the American podophyllum met with in commerce. Dymock and Hooper (1889) found 10 per cent. of the resin and Umney (1892) 12 per cent. in the Indian podophyllum, while estimations of resin in four specimens of the rhizome of *Podophyllum peltatum* by Henry and Dunstan (1898) gave respectively 4.17, 5.2, 5.4 and 5.2 per cent. From these figures the greater value of the Indian plant as a source of resin may be easily appreciated. The Indian plant seems to possess a further advantage over the American drug of commerce in that it contains a higher percentage of 'podophyllotoxin' on which the purgative action of the resin partly depends. This will be seen from the table given below in which the percentage of resin as well as the percentage of

podophyllo-toxin from both the Indian and American rhizomes are given side by side.

Variety	District or place of origin	Quantity of rhizome used	Percentage of podophyllo-toxin found	Percentage of resin found
Podophyllum emodi	Kulu (Punjab)	11·92 gm.	2·8	9·55
Do.	Bashahr (Punjab)	32·46 ,,	3·5	9·0
Do.	Chamba (Punjab)	9·81 ,,	4·7	11·12
Do.	Hazara (N.W.F.)	11·6 ,,	2·9	..
Podophyllum peltatum (U.S.A.)	U.S.A.	11·35 ,,	0·77	5·2
Do.	Do.	23·55 ,,	0·9	4·17

A recent estimation (1926) of the Indian rhizome conducted at the Calcutta School of Tropical Medicine gave 10.02 per cent. of the active principles which amply bears out the findings of the previous workers. Therapeutically, the resin from the Indian variety has also been found to be quite as active as, if not more than, the imported root.

Economic Aspects:—Even with all these advantages, *P. emodi* from the Indian sources cannot compete with the American variety and most of the drug manufacturers in India are using the American product in their factories. The reason is not far to seek. The collection of the Podophyllum rhizome growing so extensively in India was never carried out scientifically with the result that no standard of uniformity of the drug was maintained. We understand that formerly there was a podophyllum plantation in Hazara where the drug used to be cultivated but this has been abandoned since 1913. Podophyllum collected in all seasons, localities, and elevations does not contain the same amount of resin nor does the resin yield the same amount of active principles, podophyllo-toxin and podophyllo-resin. Hap-hazard collection without any attention

to these principles has damaged the reputation of the drug to a great extent, and as there is no systematic cultivation to ensure regular supplies, the manufacturers find it difficult to rely on the crude drug obtained from the merchants and collectors. The Indian drug pushed itself into the market during the Great War when the foreign supplies were restricted or practically cut off, but the situation has changed again. Unless more attention is paid to proper collection and drying of the rhizomes or the plant is systematically cultivated in suitable places, it appears unlikely that the Indian drug will be utilised even in India where the American drug is offered at a very low price. Cultivation of podophyllum is not difficult. In upland localities with sufficient moisture, the growth is very satisfactory, and within two years rhizomes are fit to be collected and sent to the market.

References :—

(1) Dutt, 1928, *Commercial Drugs of India;* (2) Dunstan and Henry, 1898, *J. C. S. Trans.*, page 209, (3) Chopra, R. N., and Ghosh, N. N., 1926, *Ind. Jour. Med. Res.*, Vol. XIII, Jan.

PSYCHOTRIA IPECACUANHA (N.O. Rubiaceæ)

Cephælis Ipecacuanha

Ipecacuanha is a well-known drug which is official in the pharmacopœias of many countries. It is the dried root of *Psychotria ipecacuanha* which is a native of Brazil and is extensively exported from Rio de Janeiro to different parts of the world. Two other varieties of Ipecacuanha namely 'Minas ipecacuanha' (cultivated in Minas Geraes in Brazil) and 'Johore ipecacuanha' (cultivated in Johore and Selangor in the Federated Malay States) are recognised by the British Pharmacopœia. Another variety, 'Carthagena ipecacuanha' derived from an unidentified species of Psychotria in Columbia is also met with in commerce. The root of this variety is thicker, darker and its annulations are less marked as compared to the official root which is slender and tortuous varying in colour from

brick-red to dark-brown. The Ipecacuanha plant grows about 30 cm. in height and, from the slender root and prostrated stem, roots are given off at intervals. Some of these growths develop an abnormally thick bark and this thickened bark and thickened root constitute the drug of commerce. It is found in most parts of Brazil growing in a state of nature and is also cultivated in some of the provinces of that country for purposes of export. The exported ipecacuanha is largely sold in the markets of India.

Indian Substitutes of Ipecacuanha:—Ipecacuanha is not a native of India but from time to time a number of plants have been reported to possess similar properties and have been suggested as substitutes. *Naregamia alata* (Goanese ipecacuanha) N.O. *Meliaceæ*, Vern.—Mar.—*Tinpani, Pittvel,* is a small glabrous, undershrub with trifoliate leaves found in Western and Southern India and has been said to possess properties akin to Ipecacuanha. It was tried in Madras in acute dysentery and also as an emetic and expectorant with indefinite results. It contains an alkaloid called *naregamine* which is not related in any way to emetine. Under the name of East Indian root, the rhizome of small monocotyledonous plant, *Cryptocoryne spiralis*, N.O. *Aroideæ*, known in Tamil as *Nattu-ati-vadayam*, has been exported from Madras, but it contains neither emetine nor cephæline. *Tylophora asthmatica*, N.O. *Asclepiadeæ*, Vern.—Hind.—*Jangli-pikvan*, Beng.—*Antamul*, Tam.—*Nay-palai*, is another plant which is still used as a substitute and some believe with satisfactory results. It is a small twining plant, common in the forests throughout Eastern India, Bengal, Assam, Kachar, Chittagong, Deccan and Burma. It was first brought to the notice of the practitioners of Western medicine by Roxburgh many years ago. O'Shaughnessy confirmed Roxburgh's opinion and said that the emetic properties of the roots are well established and that it affords an excellent substitute for ipecacuanha. The properties of this plant so convinced the early workers that it was admitted as official in the Bengal Pharmacopœia of 1844. On the compilation of Pharmacopœia of India in 1868, the leaves were made official in preference to the root as they produced more uniform and certain results. *Asclepias curassavica* is still another plant which was introduced into India from the West Indies and has become completely naturalised to India. It now grows wild in many parts of South India and in Bengal. The root of this plant possesses emetic properties and hence the West Indian colonists gave to it the name of 'bastard or

wild ipecacuanha'. The active principle, however, is a glucoside *asclepine* and not the alkaloid emetine. Besides these there are several other herbs in the indigenous system which have been claimed as substitutes for Ipecacuanha, *e.g.*—*Anodendron paniculatum*, *Calotropis gigantea*, *Gillenia stipulacea*, *Euphorbia ipecacuanha*, *Boerhaavia decumbens*, *Sarcostemma glabra*, etc. Though detailed chemical and pharmacological studies of these drugs have not been made, it has been shown that none of them contain emetine or its allied alkaloids, but in most cases contain irritant substances which are responsible for their emetic properties. Some of these remedies have been actually tried in the treatment of amœbic dysentery but without success.

Ipecacuanha is a drug of very great importance to India in view of the wide prevalence of amœbic dysentery in this country. An analysis of a large number of stools examined in the Department of Protozoology, Calcutta School of Tropical Medicine and Hygiene, showed a general incidence of 14 per cent. and from this the large demand for this drug can be easily estimated. As the drug is not grown in India, large quantities of the crude drug and also the alkaloid emetine are imported every year. Good quality of ipecacuanha root can be grown in India and sufficient quantities could be produced to meet the demand. The Government of India were not slow to appreciate the advantages likely to ensue by such an enterprise and as early as 1916-17, ipecacuanha plantations were started in the Nilgris and at Mungpoo near Darjeeling. Later, plantations were also started in Burma. The plants seeded well and it appeared from the reports for the year 1920 that there was every chance of the cultivation proving a success if plants could be reared from the seeds sown. The report for the year 1922 showed that the ipecacuanha plants were doing very well, their numerical strength had considerably increased and extensions to the existing nurseries were being contemplated. The prospect appears to be very hopeful but there are certain difficulties. Excessive daily fluctuations of temperature seem to affect the plantations badly and unless very elaborate arrangements are made to counteract them there is chance of the whole stock degenerating. In spite of these difficulties, the stocks of the Mungpoo and other plantations have so far done well and it is

understood that nearly 226,496 plants are now grown in Mungpoo alone. In the Burma cinchona plantations, nearly 68,852 plants have thus far been reared. The quantity of root produced is quite satisfactory as will be evident from the following table which gives the comparative figures of the total alkaloids and emetine contents of the different roots on the market.

		Total alkaloids	Emetine
Brazilian root	...	2.7 per cent.	1.35 per cent.
Brazilian stem	...	1.80 ,, ,,	1.18 ,, ,,
Columbian root	...	2.20 ,, ,,	0.89 ,, ,,
Indian root	...	1.98 ,, ,,	1.39 ,, ,,

A perusal of the above table will show that the emetine content of the Indian root compares very favourably with the Brazilian root though the total alkaloids are not so high. The Columbian root is very rich in total alkaloids but the proportion of emetine is very small for commercial purposes. Emetine in a pure condition, obtained from the Indian ipecacuanha, is now available on this market, but the quantity is insignificant compared to the demand.

Attempts have been made to grow ipecacuanha in other parts of the world. In Java and Ceylon the cultivation did not prove a success but in the Straits Settlements and the Federated Malay States the plant did very well especially in the rubber plantations, and ipecacuanha root of an unusually fine appearance and rich in .alkoloids is now exported in considerable quantities. If more attention is paid to the growing of ipecacuanha in India and suitable tracts of country are found where the variations in temperature are small, India could not only supply her own needs but could produce a large surplus for export.

References :—

(1) *Reports of the Government Cinchona Plantations, Bengal,* 1919-20, 1922-23, 1923-24; (2) Carr, F. H., and Pyman, F. L., 1914;

J. C. S. Trans., p. 1591; (3) Pyman, F. L., 1917, *J. C. S. Trans.*, p. 419; (4) Pyman, F. L., 1918, *J. C. S. Trans.*, p. 222; (5) Chopra, R. N., and Mukerjee, B., 1931, *Ind. Med. Gaz.*, February.

RHEUM EMODI (N.O. Polygonaceæ)

Indian Rhubarb

VERN.—Hind. & Beng.—*Revand-chini*; *Rheuchini*; Bomb.—*Ladaki-revanda-chini*; Punj.—*Rewand-chini*; Tam.—*Nattu-ireval-chinni*; Tel.—*Nattu-reval-chinni.*

Rhubarb is largely employed in Western medicine as a purgative. In the ailments of children it is specially valuable and has been very commonly used. In fact, it is one of the everyday nursery remedies. The commercial rhubarb, known as Chinese, Russian and East Indian, is said to be obtained from *R. officinale* and *R. palmatum* which grow in South-East Tibet and North-West China. Rhubarb is brought from China through Persia and thence to India; it is also imported to a certain extent from London. In the Himalayas, *Rheum emodi* is found growing wild in various parts of Nepal and Sikkim at altitudes of 4,000 to 12,000 ft., along with some of the allied species such as *R. moorcroftianum*, *R. webbianum* and *R. spiciforme*. The Himalayan rhubarb is darker in colour and coarser in texture than the Chinese variety, is not decorticated and yields a brownish yellow powder instead of the bright yellow powder of the Chinese rhubarb. It is considered of little commercial importance as it is commonly believed to be of an inferior grade to the Chinese drug. Considerable quantities are, however, annually conveyed to the plains from the Kangra district of the Punjab for use in the indigenous medicine. Indian rhubarb was tried by the Indigenous Drugs Committee but was not found to be very satisfactory. The reasons adduced by the Committee are, however, not convincing. The following analysis by Elborne shows the percentage

composition of various samples of English and East Indian rhubarb. It is evident from this that the Indian rhubarb is not lacking in the purgative principles (the anthraquinone derivatives) which characterise the foreign and official rhubarb.

	Rheum emodi (low cultivation)	Rheum emodi (high cultivation)	East Indian Rhubarb	Russian Rhubarb
Moisture ...	6.06	7.9	5.4	12.6
Ash ...	9.33	4.9	9.28	6.63
Mucilage soluble in water ...	6.5	4.8	4.0	5.5
Cathartic acid ...	3.5	3.2	4.5	3.2
Organic acids, *e.g.*, gallic acid, etc. ...	3.3	2.2	3.0	4.5
Resinous substance soluble in alcohol	2.6	2.0	4.6	5.2
Fat and free chrysophanic acid soluble in petroleum ether	0.4	0.3	0.7	1.5

It has been found that rhubarb cultivated in India with due care is as good as the imported Chinese rhubarb. The root of *Rumex nepalensis* which grows abundantly in some parts of India is sold under the name of 'Rewandchini' in the bazars of Bengal. It has purgative properties similar to rhubarb, and is also used as a household remedy but no definite information is available regarding its usefulness as a substitute for the commercial rhubarb. Good rhubarb can be grown in India and systematic cultivation of this plant is likely to be a paying proposition. Rhubarb has already been successfully grown in certain parts of Assam but this is used mostly by the local people as food and not utilised in medicine.

References :—

(1) Tutin and Clewer, 1915, *J. C. S. Trans.*, p. 946; (2) Dutt, 1928, *Commercial Drugs of India.*

RICINUS COMMUNIS (N.O. Euphorbiaceæ)

Castor Seeds

VERN.—Sans.—*Eranda,* Hind.—*Arand, Erand ;* Beng.—*Bherenda ;* Punj.—*Arand ;* Bomb.—*Erendi ;* Tam.—*Amanakkam-chedi.*

Castor oil is derived chiefly from the seeds of *Ricinus communis,* but the seeds of certain allied species like *R. viridis,* etc., are also useful. Although apparently indigenous to Africa, *Ricinus communis* grows so extensively in India that there has been a lot of speculation as to whether it is really a native of India. The plant has been cultivated in India for many centuries. Two forms are known :—(*a*) A perennial bushy shrub or a small tree grown usually as a hedge plant which has large fruits and large red seeds yielding as much as 40 per cent. of the oil. This is used chiefly for illumination and lubrication purposes. (*b*) A much smaller, annual plant grown as a distinct crop has small grey seeds with brown spots which yields as much as 37 per cent. of the oil. This is used chiefly for medicinal purposes. The plant is cultivated throughout India, particularly in Madras, Bombay and Bengal, and large quantities of the seeds are exported.

The fixed oil of the commerce is obtained from the seeds by two processes :—

(1) *Cold drawn.* When extracted without the aid of heat it is colourless or faintly yellow or straw-coloured, practically odourless, with a bland and slightly acrid taste.

(2) *Hot drawn.* In India, this is done by boiling the seeds with water and skimming off the oil. The hot pressing process commonly in use in this country consists of burning a slow fire under the mill; this liquefies the oil and increases the yield. The oil is bleached by exposure to the sun and is clarified by boiling with water which coagulates the proteins and dissolves out the mucilaginous matrix.

There are several qualities of this oil in the market. For medicinal purposes, the seeds are hand-cleaned and husked, the kernels dried in the sun and afterwards broken in a crushing machine. It is understood that at present most of the oil is extracted by hydraulic presses in Calcutta. The advantage of this process is that it is less complicated and the acridity and nauseousness of taste commonly

associated with the oil are avoided. Only half of the available oil is extracted by first pressure; the mass is subjected to a second pressure giving an additional 16 per cent., which is used as a lubricant.

Chemistry of Castor Oil.—The oil chiefly consists of ricinoleate of glycerol, or tri-ricinolein with a small quantity of palmitin and stearin. Unlike most fixed oils, castor oil possesses the remarkable property of mixing with absolute alcohol and glacial acetic acid in all proportions. The glycerides of ricinoleic acid $C_{17}H_{32}(OH)COOH$ (which is a hydroxy acid) are mainly responsible for the purgative effect. When given by the mouth the oil is saponified and free acid is liberated which produces the effect. Apart from the oil which is contained in the kernels, a very toxic substance is also present in the seeds. This poisonous constituent is a body of albuminoid nature and is named *ricin*. It is a powerful poison having a definite effect on the coagulation of blood, it has no purgative effect but produces hæmorrhagic inflammation of the gastro-intestinal tract even when given subcutaneously. It is not present in the oil to any extent.

Economic Aspects:—Though the largest area under cultivation is in this country, considerable quantities of castor seeds are annually gathered and used for producing the oil in several West Indian Islands, North America, Algiers and Italy. The ricinus plant was known as an oil plant in ancient Egypt and there is also evidence to show that the oil has been known in India for a very long time. Both castor seeds and castor oil form important articles of commerce. Medicinally a considerable quantity of the oil is used all over the world. An enormous amount, much larger than the quantity used for medical purposes, is consumed in the manufacture of soap, leather oil and as a lubricant in air-craft engines and for other industrial purposes. India is by far the largest producer and carries on a large export trade. A glance at the table of sea-borne trade returns will show that varying quantities ranging from 474,451 gallons to 699,626 gallons of the oil have been exported during the past five years (1924-29) fetching from Rs. 10,12,585 to Rs. 18,69,869. Large quantities of castor seeds were also exported during the same period and this fetched from Rs. 288,66,665 to Rs. 258,32,835.

Notwithstanding such enormous production it is disappointing to note that the best qualities of medicinal oil are not produced in India to supply even her own demands. Only

crude oil is manufactured and this is mainly used for industrial purposes. The best oils for medicinal purposes are the Italian or French oils prepared by cold expression. The first pressing only gives a good quality of oil and a yield of about 33 per cent. is obtained from the seeds as compared to 40 to 45 per cent. which might have been obtained after the final pressing. The Italian and French oils are expressed from the seeds after they are decorticated and the husks removed ; they are, therefore, milder in taste as compared with the Indian oils. Production of good medicinal oil in bulk does not present any special difficulties in India and there is every reason to believe that the extraction will be remunerative, and India will be able to meet her own requirements of one of the cheapest and most important purgatives of the Pharmacopœia. Purification of the oil is also beset with no great difficulty.

References :—

Andés, L. E., 1917, *Vegetable Fats and Oils.*

ROSA DAMASCENA (N.O. Rosaceæ)

The Rose

VERN.—Hind.—*Gulab-ke-phul* ; Beng.—*Golap-phul* ;
Bomb.—*Gul* ; Tam.—*Gulappu.*

The medicinal use of rose water and the oil or otto (attar) of rose is very limited. Rose water is mostly employed in lotions and collyria and the oil is used as a flavouring agent to mask the taste of many obnoxious preparations. In the Indian indigenous medicine, rose petals are used in the preparation of a laxative conserve called 'Gulkand'. It is, however, widely used in perfumery and is prized in many countries for its delicious aroma. The chief centre of rose industry is Bulgaria where very extensive plantations are found in the valleys and southern slopes of the Balkan Mountains. It has been estimated that the producing area has an extent of 80 miles in length and 30 miles in width. The production is enormous. On an average 8,000,000 kilos to 9,000,000 kilos of

flowers are harvested annually yielding from 2,050 kilos to 3,000 kilos of the essential oil. The following figures regarding the export of rose oil from Bulgaria in 1926 will show the importance of the industry and the demand in the various countries:—France 1,455 kilos; United States 975 kilos; Germany 311 kilos; England 190 kilos; other countries 172 kilos; total 3,103 kilos.

Besides this, a large quantity of rose extract was prepared which is steadily obtaining greater significance in modern pharmacy.

Rose is also cultivated in several other places in Europe, *e.g.*, France, Italy, Greece and Germany. In the East, Persia has been famous for its otto of rose for centuries and it is even thought that distillation of rose first originated in that country. Most of the rose grown in that country is utilised for her own needs but sometimes dried petals are exported to India for the manufacture of rose water.

In India at one time roses used to be cultivated very extensively. It is said that rose culture has been carried on at Ghazipur for nearly 250 years. To this day, Ghazipur remains the largest centre of rose production in India. It is also cultivated in Lahore and Amritsar in the Punjab, Cawnpur, Aligarh and Hathras in the United Provinces and to some extent near Patna in Bihar and Orissa. Rose water is the chief product but very little true essential oil is extracted at present. In fact, the industry has gone down to a very low level. The quantity of rose water and otto produced in this country is not sufficient to meet the internal demands and therefore large quantities are imported from abroad. There is, however, an ample scope for a large rose-products industry in India. The rose grows best at altitudes of 900 to 1,500 ft. but it is cultivated up to 2,500 ft. and even 3,000 ft. The factors contributing to the successful cultivation of rose in Bulgaria, such as abundance of rain, sandy rich well-drained soil, sloping ground and the protection of the rose bushes from high winds, can be easily obtained in many localities in India. It is also possible to grow in India the species of rose grown in Bulgaria namely *R. damascena* (red rose). Besides

this, an enormous quantity of wild hill roses grow throughout the North-West Himalayas and Kashmir and are at present allowed to go waste. These too may be profitably utilised by adopting the same methods as in countries where perfume from wild flowers is extracted. At the same time, attention should be directed towards the improvement of the Indian roses which are at present poor in essential-oil contents as compared with the Bulgarian and French roses.

By using freshly-plucked flowers and discarding the primitive methods of wasteful distillation, it has been reported that the yield could be increased from 0.004 to 0.025 per cent. With an average yield of 0.025 per cent. and the yield of flowers at 1,500 lb. per acre there would be no difficulty in competing with the Bulgarian product.

References :—

(1) Finnemore, 1926, *The Essential Oils*; (2) Dutt, 1928, *The Commercial Drugs of India*; (3) Schimmel & Co., 1928, *Report*.

SANTALUM ALBUM (N.O. Santalaceæ)

VERN.—Sans.—*Swet chandan* ; Hind.—*Safed-chandan* ; Beng.—*Sada-chandan* ; Tam.—*Shandanak kattai*.

The wood of *Santalum album* (swet chandan) was highly prized during antiquity in India and China on account of its peculiar odour. It has occupied a very important place in Hindu religious ceremonials. The Brahmins used a paste made from the wood for their sectarial marking. The Parsis used it for the fire in their temples. It was regarded as the most durable because it is not touched by the white ant which destroys so many other varieties of timber. Sandalwood is found mentioned in the earliest Sanskrit and Chinese literature. The Egyptians came to know about it as early as the seventeenth century B.C. It is a small, evergreen tree possibly indigenous to India though opinions differ among the botanists as to the real locality of origin of the plant (Kew Bulletin No. 5). It either grows wild or is cultivated in Mysore State, Coorg,

Coimbatore and the southern parts of Madras. The territory in India from which most of the wood is obtained constitutes a strip of about 240 miles long and 16 miles wide, starting from the Nilgiri Hills and extending north and north-west through Mysore. In this region, the tree grows at altitudes from the sea level to about 4,000 feet. The total area of sandalwood plantations has been estimated to be amounting to nearly 6,000 square miles of which about 85 per cent. is in Mysore and Coorg.

The sandalwood tree is of a parasitic nature. A few months after germination, haustoria from the roots penetrate into the roots of grasses, small shrubs and herbs and eventually of large trees. The young plants are planted with some other young trees to serve the purpose of a host, in baskets made of the sheaths of bamboo leaves. It is a delicate tree and suffers much from accidental injuries in the process of transplantation. It is also likely to be affected very commonly with a disease known as the 'spike' disease which is very infectious and destroys wide tracts, especially where the trees are close together. Much care, therefore, is needed in its proper cultivation. The influence of the soil also plays a very important part in the growth of this plant. When grown away from its natural habitat, it tends to lose much of its essential oil for which it is esteemed in medicine. The trees growing on hard, rocky, ferruginous soils are richer in oil than those growing on fertile tracts. Attempts are said to have been made to grow sandalwood and to distil the oil in other parts of India outside Mysore, but these have not met with much success. Records show that sandalwood oil used to be distilled in Kanauj (U. P.) some time ago but nothing more is heard about this enterprise, and it is likely that the industry has died a natural death on account of the scarcity of sandalwood in those parts. The trees mature in 18 to 20 years, when the heartwood is developed to within 2 inches of the surface. The tree is then ripe for felling. The bark is removed and the white outer sapwood and branches which are odourless are rejected. The cleaned heartwood is then sawn into billets about 2½ feet long, trimmed and kept for drying in a closed

warehouse. This process is said to improve the aroma of the wood. The heartwood is equivalent to about one-third of the tree by weight.

Sandalwood Oils of Commerce:—India is not the only country where sandalwood is grown. A small amount is obtained in Eastern Java in the Sandalwood Islands. The wood and sometimes the oil enters into commerce *via* Macassar (in Celebes) and is known as the 'Macassar sandalwood oil'. This oil, although the product of *Santalum album*, is not of as fine an odour as the Indian distillate. Woods of some other trees have, from time to time, been used as substitutes for genuine sandalwood and great confusion exists in view of the fact that these oils pass as sandalwood oil in commerce. The so-called 'West Indian sandalwood oil' is not a true sandalwood oil at all, as it is not derived from *Santalum album* but is the product of *Fusanus acuminatus* (*Santalum preissianum*). 'East African sandalwood oil' is obtained from a species of Osyris, probably *Osyris tenuifolia*. The 'West Australian sandalwood oil', though derived from *Fusanus spicatus*, resembles the Indian oil very closely and in recent years has come to be regarded as a serious competitor of the true 'East Indian sandalwood oil' both in commercial and in medicinal uses.

Chemistry:—The essential oil of sandalwood is distilled from small chips and raspings of the heartwood of the tree. The roots are also used and they are considered to yield a larger and a finer quality of oil. The yield of oil is estimated to be from 2.5 to 6 per cent. Owing to the close-grained structure of the wood and to the low volatility of the oil, distillation is extremely slow and consequently expensive. The oil is extremely viscid, of a light yellow colour and possesses a characteristic roseate and penetrating odour and a bitterish slightly acrid taste. It is soluble in from 3 to 6 volumes of 70 per cent. alcohol (by volume) at 20°C and has got the following characters:—Specific gravity 0.973 to 0.985; optical rotation −14° to −21°; refractive index 1.5040 to 1.5100; acid value 0.5 to 6; ester value 3 to 17; sesquiterpene alcohols (mostly santalol) 90 to 96 per cent.

The oil consists in the main of alcohols and their corresponding aldehydes. A body or mixture of isomers known as santalol is the principal constituent of the oil, occurring therein to the extent of 90 per cent. or more. It is a mixture of two isomers, known as

α-santalol and β-santalol. The rest is composed of aldehydes and ketones, *e.g.*, isovaleric aldehyde, santenone, santalone, etc.

Adulterants :—The oil of commerce is frequently mixed with cedarwood oil to the extent of 10 per cent.; castor oil is also used as an adulterant in India. Both adulterants are easily detected by alteration in the physical characters, in the former by the decreased solubility in alcohol and in the latter by high ester value. Glyceryl acetate, benzyl alcohol, terpineol, etc., are some of the other adulterants met with.

Medicinal Uses :—Both the sandalwood and the oil distilled from it have been used in the Hindu materia medica for many centuries. The wood is described in the Hindu medical works, as bitter, cooling, astringent and useful in biliousness, fever and thirst. An emulsion made of ground sandalwood is used as a cooling application to the skin in erysipelas, prurigo and sudamina. Ground up with water into a paste, it is commonly applied for local inflammations, and to the temples in fevers and hemicrania; it is used as an application in skin diseases to allay itching and inflammation. It has also been used as a diaphoretic and as an aphrodisiac.

Dr. Henderson of Glasgow was the first to direct the attention of the European physicians to the use of the oil as a remedy for gonorrhœa and since his time it has been employed internally in many cases where copaiba and cubebs had previously failed. It is preferable to copaiba as it does not communicate an unpleasant odour to the urine nor does it so readily produce untoward effects.

Economic Possibilities :—In Mysore and in Coorg, the sandalwood trees belong to the State, while in the Coimbatore and Salem districts of Madras, although there is no absolute monopoly, the sandalwood forests are preserved and are strictly administered by the Forest Department. Before the British conquered Mysore from Tipoo Sultan, the rulers of that country had exercised a royal prerogative over the sandalwood tree and had imposed very stringent regulations against its exploitation without proper authority; in fact the tree, wherever it occurred, and whether artificially or naturally grown, was the property of the rulers and not the occupier of the land. The reason for the exercise of all these regulations

may be appreciated when we consider that a considerable amount of export trade existed *in this wood for many years.* As far back as 1825, there is mention of this trade in the 'coastal trade returns of India' as well as in the 'statistics of foreign trade'. An idea of the amount of revenue derived in the latter part of the last century may be estimated by a reference to the export figures of 1885-90. During the five years on an average about six lacs worth of sandalwood was bought from India by other countries. Mysore was the chief source and it was stated that the revenue derived from the sale of sandalwood formed one of the principal items of forest revenue in Mysore. Coming to more recent times, we find that before the War the annual production of the wood amounted to 2,500 to 3,000 tons of which 500 to 600 tons were consumed in the country and the remainder exported. This continued till May 1916 when the Bangalore sandalwood factory was opened. The Bangalore factory, from the Indian point of view, has been a decided success. A small initial output of 2,000 lbs. a month has grown rapidly, and in 1921, 55,641 lbs. of oil were exported as follows:—

United Kingdom—26,931 lbs; Japan—12,336 lbs; France—7,818 lbs; Straits Settlements—1,986 lbs; Hongkong—1,974 lbs; Anglo-Egyptian Sudan—1,555 lbs; United States—1,000 lbs; other countries—701 lbs; total—54,301 lbs.

In 1922 and 1923, the export figures were 121,602 and 149,464 lbs. respectively. The starting of the Bangalore factory has given a new turn to the sandalwood oil trade in India. Considering that a ton of wood yields, on an average, about 105 to 110 lbs. of the oil the foreign buyers are quickly appreciating the advantages of importing the oil and saving a large sum of money on the freight. The Mysore Government has also erected another factory at Mysore with a producing capacity of 20,000 lbs. a month to meet the increased European demand. The whole of the output of sandalwood in Mysore, however, is not distilled in the State-owned factories. For fiscal reasons, some portion is distilled in New

York. The returns for the year 1927-28 will give an idea as to the relative amounts distilled.

	Bangalore			Mysore			New York			Total		
	Tons.	cwt.	lb.	Tons.	cwt.	lb.	Tons.	cwt.	lb.	Tons.	cwt.	lb.
Quantity of wood distilled	796	2	96	849	18	0	375	0	0	2,021	0	96
Quantity of oil obtained	167,260 lbs.						45,840 lbs.			213,100 lbs.		

Besides the oil distilled in the Mysore and the Bangalore factories which are owned by the State, a certain amount of oil is also prepared by private individuals. Much of this is used by the Indian perfumers who are said to require about 10,000 to 15,000 lbs. per annum.

America is the most important sandalwood consuming country in the world at the present time and the oil is chiefly used there in the manufacture of toilet soaps. A study of the imports of sandalwood oil into America showed that the quantity decreased from about 50,000 lbs. in 1924 to about 5,000 lbs. in 1927 and then rose again to about 12,000 lbs. in 1928. It is difficult to find out why the supply showed this large decline. It is said that the amount of wood cut has been decreased by 70 per cent. because the forests are becoming depleted on account of indiscriminate felling. The shortage of sandalwood oil appears to be keenly felt in America as is evidenced by the fact that attempts are being made to tap other sources of the oil. The Australian oil has been put forward for consideration of the United States Pharmacopœia Revision Committee with a view to its acceptance. It has been shown by chemical analysis that the Australian oil contains about 95 per cent. of santalol. It does not possess the sweet odour of the Indian oil and its optical rotation differs markedly from that of the Indian oil. By fractional distillation of Australian sandalwood oil, however, a fraction is obtained which has an odour like that of sandalwood oil and this can be adjusted so as to come just within the British Pharmacopœia limits. [The B. P. minimum is -13°; Mysore oil has

got a rotation of not less than −17° ; if the original Australian oil is fractionated and blended with oil from *Santalum lanceolatum* which has a rotation of about −40°, it can come just within B. P. limits]. Its effect on the gastro-intestinal and other systems has not yet been thoroughly investigated and it is still open to doubt whether it will prove therapeutically equivalent to the Indian oil. The new French Codex has recognised the 'West Australian oil' under a separate description in addition to the 'East Indian oil'. If this step is followed by others and the oil is recognised by the British and the United States Pharmacopœias, it will flood the markets of those countries with the result that India may be deprived largely of this important trade. It is being already replaced to a large extent in the fields of perfumery and soap-making though not in medicine and pharmacy.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Parry, E. J., 1931, *Sandalwood Oil*, Published by the Govt. of Mysore; (3) Parry, E. J., 1926, *Chemistry of Essential Oils*, Fourth Edition, Vol. I; (4) Venkatasaiya and Watson, 1928, *Jour. Soc. Chem. Ind.*, Vol. 44.

STROPHANTHUS (N. O. Apocynaceæ)

Strophanthus is another important drug of the British Pharmacopœia which is used by the physicians on account of its properties as a cardiac tonic. This plant is a native of the African coasts and India imports large quantities of stropanthus preparations every year. At least five species of stropanthus are indigenous to the tropical regions of India and the Malayan Peninsula, but so far no attempt has been made to find out the strophanthin content of these plants to see whether these might be utilised medicinally in place of the imported variety. Some of these plants are very beautiful and would adorn any garden. Strophanthus cultivation, moreover, is not beset with difficulties under conditions existing in India and it has been tried experimentally with a certain degree of success in the Royal Botanical Gardens. An investigation into

the possibilities of its cultivation in India would interest the drug manufacturers.

STRYCHNOS NUX VOMICA (N.O. Loganiaceæ)

VERN.—Hind.—*Kuchla* ; Beng.—*Kuchila* ; Bomb.—*Kajra* ; Tam.—*Yetti* ; *Yettie-kottai*.

Nux vomica grows wild and plentifully throughout tropical India up to an altitude of 4,000 feet above the sea level. It is not frequently met with in Bengal but grows abundantly in Southern India, in the Madras Presidency, Cochin, Travancore and the Coromandal coast. A species of strychnos trees, *S. blanda* grows in Burma but medicinally it is of no importance as it does not contain either strychnine or brucine. Plantations have also been started in Orissa and neighbouring places. Though no definite figures are available as regards the area under cultivation, seeds are already being exported from the port in Orissa and it is reported that a quantity is available for internal consumption. It may, therefore, be expected that the plantations are doing well.

Nux vomica is one of the most important drugs used in medicine. The powdered seeds and sometimes a decoction made from them have been used by the Hindu physicians in the treatment of dyspepsia and diseases of the nervous system. In the form of extracts and tinctures and as alkaloid, strychnine is very commonly used in Western medicine. In spite of its wide-spread use and the abundance with which the drug grows in India, very little interest has been evinced in *the utilisation of the raw materials locally. The foreign* manufacturers, however, have not failed to appreciate the value of the Indian seeds and have systematically exported them in large quantities through their local agents. Cochin in Southern Indian is the chief port of export, though not very insignificant amounts are sent out from such ports as Madras, Bombay and Calcutta. The total exports from India approximate about 45,000 cwts. to 50,000 cwts. annually, valued at about 3,00,000 rupees, almost entirely to Great Britain.

Galenicals like tinctures and extracts and purified alkaloids like strychnine and brucine are manufactured there and sent to India for use. The value of the imported refined products is nearly 100 times greater than that of the exported nux vomica seeds, and strychnine could be economically manufactured in India in view of the abundant supply of the seeds. From theoretical considerations and from a study of the economic aspects, it would appear very probable that, if taken up on a large scale, strychnine manufacture in India would amply pay its way and leave a handsome margin of profit to the manufacturers. This will be seen from the fact that the seeds of *Strychnos nux vomica* are sold in Orissa at Re. 1-4-0 per maund (105 lbs.), delivered washed and dried at the buyer's godown, whereas the wholesale market price of strychnine alkaloid is Re. 1 per ounce and if small quantities are purchased, the price charged for is Rs. 2-8-0 for the same quantity. Indian nux vomica seeds have been found to contain from 2.6 to 3 per cent. total alkaloids approximately, of which 1.25 to 1.5 per cent. is strychnine and the rest mainly brucine. On the basis of this yield, one cwt. of seeds would yield nearly 20 ounces of strychnine which would fetch from Rs. 20 to Rs. 50 according to the current wholesale and retail market prices respectively. In actual practice, however, difficulties have to be faced. Experiments carried out on a moderate scale in connection with the extraction of strychnine and brucine from Indian nux vomica by Watson and Sen at the Technological Institute, Cawnpore, show that the margin of profit, though quite handsome, is not large enough to attract manufacturers. Their process consisted in mixing the powdered nux vomica seeds with lime and water, drying, powdering and extracting with hot kerosene oil. This gave satisfactory results, but they found that on a large scale the drying of the material is one of the most expensive parts of the process, both as regards steam and initial cost of the plant. Strychnine has been successfully manufactured by certain Calcutta firms of pharmaceutical chemists and has been actually put on the market though the quantity produced has never been very large. Recently, the manufacture of strychnine

had to be stopped in Calcutta on account of the high price of the seeds—Rs. 6 per maund of 82 lbs., as compared with the original price Rs. 4 to Rs. 4-8-0 per maund. At this price, the Indian manufacturers cannot compete with the European producers who undertake extraction on a very large scale. The greatest difficulty in the way of the Calcutta manufacturers appears to be the enormously high price for the seeds they have to pay on account of the high transportation charges by railway (price in Calcutta is Rs. 6 per maund of 82 lbs.; price in the Orissa ports—Re. 1-4-0 per maund of 105 lbs.). The European manufacturers on the other hand, get the same article landed there at a much less cost as the shipping companies carry this commodity as ballast at very low freight. If the question of transport is solved and factories are started near the locality where nux vomica grows, strychnine manufacture would most likely be a profitable proposition. If this is done, India can not only supply her own requirements, but can also have a good prospect of a large export trade. Even at the present prices, large quantities have lately been imported into Australia to kill rodents which abound there. The trade in nux vomica seeds is practically the monopoly of India and Ceylon. Though the alkaloids occur in numerous species of strychnos, they are not present in sufficient amounts to serve as commercial sources. The only real competitor is *Strychnos ignatii*, a climbing plant of the Philippine islands from the fruits of which are derived the 'St. Ignatius' beans. These beans contain both strychnine and brucine in fairly large amounts and have been successfully used in extraction of alkaloids on a commercial scale. The demand for strychnine, however, is increasing steadily as it is being employed largely as an insecticide and as an animal poison. If attention is paid to the proper cultivation of the trees and better methods of collection of the seeds than is at present in vogue, the country will gain appreciably.

References :—

(1) Thorpe, *Dictionary of Applied Chemistry;* (2) Dutt, 1928, *Commercial Drugs of India;* (3) Watson and Sen, 1926, *Jour. Ind. Chem. Soc.*, Vol. III, p. 397.

SWERTIA CHIRATA (N.O. Gentianaceæ)

Chiretta

VERN.—Sans.—*Kiratá-tiktá, Bhunimba* ; Hind.—*Chárayatah* ; Beng.—*Chirétá* ; Bomb.—*Chiraita, Kiraita* ; Tam.—*Nila-vémbu.*

The herb grows abundantly in the temperate Himalayas from Kashmir to Bhutan and Khasia Range between 4,000 to 10,000 ft. above the sea level. It has long been used by the Hindu physicians as a bitter tonic, stomachic, febrifuge and anthelmintic. An infusion of the drug is generally employed, but it forms part of many compound preparations. The Mohammedan physicians also use it extensively. The European practitioners in India in the early days appreciated the value of chiretta and very frequently prescribed it in place of the official gentian. The report of Fleming (quoted in Watt's *Dictionary of the Economic Products of India*) will bear testimony to the high reputation the drug enjoyed in those days. According to him chiretta possesses "all the stomachic, tonic, febrifuge and anti-diarrhœtic virtues which are ascribed to gentian and in a greater degree than they are generally found in it in the state in which it comes to us from Europe." Experiments carried out in the School of Tropical Medicine regarding the chemical composition of *Swertia chirata* also show that it can effectively replace the gentian of the Pharmacopœia. The common variety of chiretta as obtained from the Indian bazar was assayed for the contents of its bitter principle by the method suggested by Zellner.

By this method the percentage of bitter principle was found to vary from 1.42 to 1.52. This compares favourably with the bitter principle existing in *Gentiana kurroo* and there is no reason why more attention should not be paid to this drug. There are several spurious kinds of chiretta in the market as well. *S. angustifolia, S. decussata, S. corymbosa* and *S. pulchella* are used in the indigenous medicine in Southern India. Some of these are not bitter at all and are, therefore, devoid of therapeutic activity. True chiretta, *viz., Swertia chirata*

has now been recognised in the British and the United States Pharmacopœias. It is obtainable in the Indian bazars in large quantities which usually come from Nepal and are quite cheap in price.

References :—

(1) Chopra, R. N., Ghosh, N. N. and Ratnagiriswaran, 1929, *Ind. Jour. Med. Res.*, Vol. XVI, Jan.

URGINEA INDICA (N.O. Liliaceæ)

Indian Squill

VERN.—Sans.—*Vana-palándam* ; Hindi & Beng.—*Kánde, Jangli-piyaz* ; Punj.—*Phaphor, Kachwassal* ; Bomb.—*Jangli kanda* ; Tam.—*Nari-vengáyam.*

SCILLA INDICA (N.O. Liliaceæ)

VERN.—Hind. & Beng.—*Suphadie-khus* ; Bomb.—*Bhuikanda* ; Tam.—*Shiru-nari-vengayam.*

As is well-known the bulbs of *Urginea scilla* are official in the British Pharmacopœia and those of *Urginea maritima* in the United States Pharmacopœia. Both these varieties grow on the shores of the Mediterranean and are used largely in medicine. The bulbs and also the preparations made from them were and are still imported into India from countries bordering on the Mediterranean and a high price has to be paid for them. In India, two varieties of squill grow abundantly which have got properties almost identical with the official *U. scilla* and *U. maritima. Scilla indica,* Roxb. grows frequently in the sandy places especially near the sea, in the Deccan peninsula, from the Concan and Nagpur southwards. *S. hohenackeri,* Fisch et Mey, is a closely allied species met with in the Punjab. The bulbs are whitish brown in colour, scaly, about the size of a nutmeg and composed of very smooth and fleshy scales which are so imbricated that they may be mistaken for coats if not

carefully examined. They are roundish and ovate in shape, sometimes slightly compressed on the sides. *Urginea indica,* Kunth., grows in the sandy soil, especially near the sea throughout India. It also grows in the drier hills of the lower Himalayas and on the Salt Range in the Punjab and N. W. F. Province at an altitude of 2,000 feet. The bulbs are about the size of a lime and are tunicated. The outer coats are inert. The squill sold in the Indian bazars is a mixture of these two varieties. The whole bulbs are usually sold in an unsliced state, in ordinary druggists' shops, but of late sliced squills are also being supplied to the large manufacturers from Chittagong, Bombay and Jaunpur (U.P.). The two kinds have the same action and can be distinguished by the fact that Urginea bulbs are tunicated, while the Scilla bulbs are imbricated. The bulbs, though smaller than the imported variety are equally nauseous and bitter. In preparing squills for the market particular attention has to be paid to proper drying of the sliced bulbs, otherwise they may get mouldy in the course of transport and may lose their activity.

A great deal of attention has lately been paid to the expectorant, cardiac stimulant and diuretic properties of scilla. Although a useful and potent drug, on account of its irritable effects on the gastro-intestinal tract it has not been possible to use it to any large extent in therapeutics as a cardiac tonic. Efforts have, therefore, been made of late years to isolate its active principles and to see if it is possible to separate them from irritating substances contained in the bulbs. Two substances have been isolated, (1) an apparently pure crystalline glucoside named scillaren A, and (2) an amorphous complex constituent, probably a mixture of two glucosides which has been given the name of scillaren B. The latter substance is easily soluble in water while the former is practically insoluble. Both experimental and clinical experience with the drug has shown that the action of scillaren closely resembles strophanthin and it was also said that like the latter substance it suffers from the disadvantage that it cannot be given by the mouth. De (1927) showed that scillaren exerts a digitalis-like action on the heart and that its irritant action on the alimentary canal is slight and

that it is absorbed from the alimentary tract. Stehle, Ross and Dreyer (1931) have shown that scillaren B produced a rise of blood pressure owing to its vaso-constrictor action in animals, the amplitude of ventricular beats is increased and that the cardiac output is improved.

For many years the Indian varieties have been used as a substitute for the official varieties by the Government Medical Store Depot in Bombay for the manufacture of galenicals and the results obtained clinically have been quite satisfactory. The Indian variety was even made official in the British Pharmacopœia in 1914. *U. indica* is said to be cheaper than *U. maritima* and, if its cultivation and the method of harvesting are improved and it is grown on a large scale, it will successfully compete with the Mediterranean variety in the European market. Some of the drug manufacturers in Calcutta are using the combined bulbs of *S. indica* and *U. indica* obtained from the Chittagong hill tracts for the prepaiation of tinctures, etc., and a large trade in this drug has developed in that part. In the following table we have summarised our results of the biological assay of tinctures of scilla made from the imported and Indian varieties. The assays were carried out by Chopra and De's modification of Hatcher's cat method and gave good reduction in heart beat.

	No. of samples assayed	Up to B.P. standard	Below B.P. standard	Stronger than B.P. standard
U. indica and *S. indica* from Chittagong ..	73	64 (87.6%)	8 (10.96%)	1 (1.44%)
U. Scilla from the Mediterranean coast (imported)	28	19 (67.9%)	3 (10.7%)	6 (21.4%)

A perusal of the above table will show that the Indian squills are in no way inferior to the imported varieties of *U. scilla* and *U. maritima*.

References :—

(1) Chopra, R. N., and De, P., 1926, *Ind. Jour. Med. Res.*, XIII, April; (2) De, P., 1927, *Jour. Pharm Exp. Therap.*, Vol. 31, 6; (3) Stehle,

R. L., Ross, J. and Dryer, M. D., 1930, *Jour. Pharm. Exp. Therap.*, Vol. 42, No. 1, 45; (4) Chopra, R. N., and Mukerjee, B., 1931, *Ind. Med. Gaz.*, December.

VALERIANA WALLICHII (N.O. Valerianeæ)

Indian Valerian

VERN.—Sans.—*Tagara* ; Hind. and Beng.—*Tagar, Nahani, Shumeo, Asarún* ; Bomb.—*Tagar-ganthoda.*

Valerian is a very old remedy. It was known to the Greek physician Dioscorides under the name 'Phu' and 'Phu Germanicum' was the name used by Fuchs for it in 1542. In the middle ages it was used as a perfume and as a spice and its medicinal name 'Poor man's treacle' implied something very precious. The name valerian was used by Haller late in the 17th century and also by the English botanists. It was known from very ancient times in Germany, Russia, Greece and Asia-minor. There are two varieties of English valerian, *V. officinalis*, var. *mikanii* (Syme) and var. *sambucifolia* (Mik.) ; the latter has broader oblong lanceolate leaves, the former is more robust yielding a larger and more odorous root. The root used in the British Pharmacopœia is dull brown and yields 8 to 10 per cent. ash rich in manganese. The French-Belgian root is paler straw coloured and is at the present time the chief commercial source. It is scientifically cultivated in Belgium and also in the Department Du Nord in France, but the wild plant, which grows on the Ardennes and Vosges Mountains on moderately dry soil, is said to be much more active. A variety used to be grown in Scotland and in Derbyshire and was in great demand in America but the industry no longer exists.

The demand for valerian all over the world appears to have increased of late years. In 1918 after the Great War the price of valerian went up to at least 3 times its usual price probably on account of its extensive use in shell shock cases. Although it has been used in the treatment of hysteria and nervous troubles of women for ages, valerian has gained an added importance after recent researches on its properties and actions in neurosis and epilepsy. In view of these facts, the sources of

valerian in India were studied in detail. Most of the valerian met with in commerce in India is *V. wallichii* rhizome and is imported from Afghanistan. No effort has been made to collect the rhizome which grows in India on a large scale.

A number of species of valerian grow wild in the temperate Himalayas. *V. hardwickii* and *V. wallichii* both grow abundantly in the mountain ranges extending from Kashmir to Bhutan at altitudes ranging from 4,000 to 12,000 feet above the sea level. *V. officinalis* the official root of the Pharmacopœia, also grows in the north of Kashmir at Sonamurg at a height of 8,000 to 9,000 feet but is not nearly so common as the other varieties. The antispasmodic and stimulant properties of this plant are well-known in the indigenous medicine and have been described in the books of Hindu medicine.

Valerian is prized in medicine on account of the presence in the roots of a valuable essential oil. An average specimen yields 0.5 to 0.9 per cent. of the oil but the yield varies with the locality and the season of collection. Dutch roots are said to yield about 1 per cent. of the oil while the Swedish give a still higher percentage. The fresh roots collected in the spring gave as much as 2.12 per cent. volatile oil, but a lower yield was obtained from the autumn-gathered rhizome. The Indian valerian root, obtained from the *V. wallichii*, has been analysed by Bullock. Specimens of the root from Kashmir were also examined at the Calcutta School of Tropical Medicine and Hygiene and practically the same results were obtained. This is probably due to the fact that the rhizomes were not collected at the proper time and were not properly stored. Most of the specimens received for analysis at the School were very dry and much of the essential oil appeared to have been lost. By careful collection and storage, there is no doubt that the quality could be improved, as has been amply shown by foreign investigators. If this is done, the Indian valerian could very well be substituted for the imported rhizome.

References :—

(1) Chopra & Ghosh, 1926, *Ind. Jour. Med. Res.*, Vol. XIII, Jan.; (2) Bullock, 1925-6, *Pharmaceutical Journal*, Vol. 115, p. 122 and Vol. 117, p. 152; (3) Finnemore, 1926, *The Essential Oils*.

ZINGIBER OFFICINALE (N.O. Scitamineæ)

VERN.—Sans.—*Adrakam* ; Hind.—*Adrak*, *Adi* ; Beng.—*Ada* : Punj.—*Adrak* ; Tam.—*Inji* ; Tel.—*Allam*.

The history of ginger is interesting. Ginger appears to have been used as a spice and a medicine from early times by the Chinese and the Indians, there being numerous references to it in Chinese Medical treatises and in Sanskrit literature. The ancient Greeks and Romans appear to have regarded the spice as being of Arabian origin, owing to the fact that they obtained supplies of it by way of the Red Sea.

The use of ginger as a condiment and in medicine is so wide that it scarcely needs any description. It was at one time much employed for spicing beer, and the modern equivalent, ginger beer, is highly esteemed to-day as a beneficial cordial in cold weather. The taste of ginger being aromatic and pleasantly pungent, it finds wide employment as a spice in the preparation of dishes of a most diverse character, varying from curries to ginger bread. In virtue of its action as a carminative and stimulant to the gastro-intestinal tract, ginger plays a very useful part in pharmacy. It is much in vogue as a household remedy for flatulence, and there are numerous preparations containing ginger included in the British and other pharmacopœias.

Zingiber officinale is a herbaceous perennial, producing leafy shoots which attain a height of about 1 to 3 ft. After the flowers have disappeared and the stems have withered, ginger is ripe for collection. The rhizomes are dug up and prepared for the market in different ways. In Jamaica, the best ginger is prepared by washing the rhizomes, removing their outer coatings with a sharp knife, washing them again, and finally drying them in the sun. Sometimes, the rhizomes are parboiled before drying, the process being known as 'bleaching'. This process has nothing to commend it and may seriously affect the active principle, if carried to excess. The peeling is a matter of great importance owing to the fact that the essential oil, to which the aromatic character of ginger is due, is present

in the epidermal tissue, so that excessive scraping may impoverish the quality of the spice.

Several varieties of dried ginger are recognised, according to the country of origin and the methods of preparing it. 'Plantation ginger' consists of rhizomes formed in winter time by small portions of rhizome (each containing an 'eye') planted in the previous spring. 'Ratoon ginger' consists of new rhizomes formed by allowing portions of the first crop of rhizome to remain in the ground when the plantation ginger is harvested. The ratoon ginger is of inferior quality, the rhizomes being smallest and more fibrous than those of plantation ginger. In India, ginger is cultivated in many places, and the process of cultivation is very similar to that followed in Jamaica. Cochin ginger takes the highest rank among Indian gingers, but the districts of Rungpur, Midnapore and Hooghly in Bengal, Surat and Thana in Bombay and Kumaon in the United Provinces are also noted for production of good ginger.

Chemical Composition :—Ginger contains from 1 to 3 per cent. of a volatile oil of light yellow colour having a characteristic odour. Jamaican variety yields about 1 per cent., African from 2 to 3 per cent. and the Indian about 3.5 per cent. The pungent principles of ginger are not volatile in steam to any appreciable extent and are, therefore, not found in the volatile oil. It has, however, been isolated and been named gingerol but its true chemical nature has not yet been finally settled.

Economic Aspects :—The Jamaican ginger is the most highly esteemed variety of ginger in the market and commands the maximum price. Ginger growing in India has also a considerable market and with more attention should get wider recognition. Jamaican ginger is grown in sandy loam where good irrigation is possible in case the rainfall is unsatisfactory. The yield per acre in Jamaica is said to be on an average from 1,000 to 1,500 lbs. of dried ginger and as much as 2,000 lbs. is sometimes obtained. In Bengal, the yield is from 1,000 to 1,500 lbs., in the Punjab 2,100 lbs. and in Travancore 2,500 lbs. It will appear from the figures quoted above that as regards the quantity of production British India stands on an equal footing with Jamaica, and with scientific cultivation it may be con-

fidently hoped that the yield will increase. The United Kingdom was the best market for Indian ginger for a long time as will be evident from the following table of export of ginger to the United Kingdom in 1912 before the World War.

Exports from Different Countries

	Quantity in cwt.	Value in £
British India	... 65,544	107,464
Jamaica	... 20,996	37,180
Sierra Leone (Africa)	.. 21,860	33,280

The advantageous position of India in this business seems to be seriously attacked by the Jamaican and the African products within recent years. Thus in 1927, Jamaica exported over 1,200 tons (24,000 cwt.) of the spice. Sierra Leone (Africa) is also showing definite signs of progress, the export figure showing an amount of 1,400 tons (28,000 cwt). The export of Indian ginger has definitely gone down, as will be seen from the figures to the end of March 31st, 1929 which stood at 2,300 tons (46,000 cwt). We should not, however, forget that in India very large quantities of ginger are used in the preparation of curries and for medicinal purposes and consequently the actual amount produced may be considerably in excess of these figures if local consumption is taken into consideration.

References :—

(1) Nomura, H., 1917, *J. C. S. Trans.*, p. 769; (2) Lapworth, Pearson and Royle, 1917, *J. C. S. Trans.*, p. 777; (3) Lapworth and Wykes, 1917, *J. C. S. Trans.*, p. 790; (4) Moudgill, 1925, *Jour. Ind. Chem. Soc.*, Vol. V, p. 251; (5) Rao, Sudborough and Watson, 1925, *Jour. Ind. Inst. Sci.*, 8A, 151; (6) Finnemore, 1926, *The Essential Oils*.

PART III

DRUGS USED IN THE INDIGENOUS MEDICINE

SECTION I

DRUGS OF VEGETABLE ORIGIN

In the section dealing with the evolution of the Indian indigenous drugs in Part I, it has been pointed out that they include the drugs used in the ancient Hindu medicine and as well as those used in the Tibbi or the Mohammedan medicine. Both these systems have ministered to the needs of the population of this country for many centuries. Besides these, the drugs used in the Western medicine, which have been introduced into India and which have become completely naturalised, are also included. This last group of drugs has been dealt with in detail in Part II, and it will be observed that in that case particular stress has been laid on their economic aspects as their medical aspects are well-known. In Part III it is proposed to deal with a number of well-known drugs commonly used by the indigenous practitioners which have been worked out on scientific lines. Those drugs which have not been examined by modern methods of research have been left out and for these the reader is referred to such works as Dymock's 'Pharmacographia Indica', Watt's 'Dictionary of the Economic Products of India' and other literature mentioned in Parts I and IV.

It is fully realised that Part III of the book is very incomplete as we have only been able to deal with a small number of drugs out of hundreds that are used. It is hoped, however, that as research on these drugs progresses and more material is available, it will be possible gradually to expand this section of the book. A comprehensive list of drugs given at the end of this book will give an idea as to the enormous possibilities of such expansion.

Many of the drugs dealt with in the following pages have been investigated by workers of the Calcutta School of Tropical

Medicine, but any recent work done by other workers has also been included.

ABROMA AUGUSTA (N.O. **Sterculiaceæ**)

Devil's Cotton

VERN.—Hind., Beng. & Cutch.—*Ulatkambal*; Bomb.—*Olak-tambol.*

Abroma augusta grows wild throughout the hotter parts of India from the United Provinces to Sikkim, Khasia Hills and Assam. It is also cultivated in gardens for its showy, deep-scarlet flowers. The root of the tree is characterised by a thick fibrous brown bark and both the root and the root bark are used in medicine as an emmenagogue in menstrual disorders. The fresh viscid sap is said to be more efficacious and is used in dysmenorrhœa in doses of 30 grains a day. Thornton considered it to be useful in the congestive and neuralgic varieties of dysmenorrhœa and thought that it regulated the menstrual flow and acted as an uterine tonic. It is a very popular medicine in the indigenous systems.

Chemical Composition:—Little or no previous work has been done on this drug. The material used by the author consisted of the root secured locally. To test for the presence of alkaloids, the powdered root was extracted with Prollius' liquid. The extract taken up in dilute HCl gave all the reactions for alkaloids. The amount, however, was less than 0.01 per cent.

The petroleum ether extract showed the presence of a fixed oil and a little resinous matter; the ethereal solution gave further amounts of resin; the alcoholic extract showed the presence of an alkaloid soluble in chloroform (about 0.01 per cent.) and also some water-soluble bases in larger amounts, some carbohydrates, resins and phlobaphenes. The cold aqueous extract showed the presence of a fairly large amount of mucilaginous matter. The hot aqueous extract did not show the presence of any inulin-like substance. As the water-soluble bases were found to be predominant, the method used by Henry for the isolation of betaine, choline and other water-soluble bases was applied to a large quantity of the powdered root. The yield of the total bases was nearly 0.1 per cent.

The root, thus, has the following constituents:—(1) A fixed oil, (2) resins, (3) an alkaloid in minute quantity (0.01 per cent.), (4) water-soluble bases.

Pharmacological Action and Therapeutic Uses:—The alkaloid and different fractions obtained during the course of analysis including the water-soluble bases were passed through pharmacological tests, but no remarkable activity was manifested on the gastro-intestinal tract, circulation, respiration, etc., nor was there any marked effect on the uterus, whether virgin or pregnant, isolated or *in situ*. In the absence of any sign of physiological activity, clinical trials were not carried out. S. Sirkar of Dacca (unpublished) has recently found in an aqueous alcoholic extract of the plant, fairly large quantities of magnesium salts in combination with hydroxy acids, besides gums, resins and other organic residues. In view of the fact that magnesium salts of some hydroxy acids are valuable as styptics, he thinks that the utility of *Abroma augusta* in uterine hæmorrhages might be due to the presence of the magnesium salts. Further work is necessary to determine the true nature of the active principles.

References:—

(1) Henry, 1925, *Jour. Amer. Chem. Soc.*, p. 2721; (2) Chopra and Ghosh, 1929, *Ind. Jour. Med. Res.*, Vol. XVII, p. 377.

ABRUS PRECATORIUS (N.O. Leguminosæ)

Indian or Wild Liquorice Root

VERN.—Sans.—*Gunja*; Hind.—*Gaungchi, Rati*; Beng.—*Kunch*; Tam.—*Gundumani*; Tel.—*Guri-ginja*.

It is a beautiful woody climber, found all through the plains of India and Ceylon and also along the Himalayas ascending to an altitude of 3000 ft. It flowers in August and September and the pods ripen by the end of the cold season. The seeds are slightly smaller than ordinary peas and are usually of a bright scarlet colour with a black spot at one end, though white seeds are also met with. The root is woody, tortuous and much branched. Mohammedan writers describe

the seeds under the name 'ain-ed-dik' (cock's eye) and state that they are hot, dry, tonic and aphrodisiac. The small, shining red seeds are used by goldsmiths as weights, each weighing about 1.75 grains. They are also used domestically as ornaments and decorations for boxes, etc. The seeds are poisonous and are used by sweepers and other lower class people for criminally poisoning cattle to obtain their skins. The seeds are ground into a paste and made into needles which are inserted under the skin of the animal. Similar needles have also been used to produce criminal abortion. The practice, however, is gradually disappearing.

Chemical Composition :—A watery extract of the bruised seeds of *Abrus precatorius*, when dropped into the eyes, produces an inflammation of the conjunctiva. This irritant action was thought to be due to a special bacillus called jequirity bacillus, which grows in the infusion of the seeds. Later observations, however, show that the toxic and irritant actions were due to a principle called *abrin* which is of the nature of a toxalbumin. Besides abrin, the seeds also contain poisonous proteins, a fat-splitting enzyme, abrussic acid, hæmagglutinin and a quantity of *urease*. The shell of the seeds contains a red colouring matter. The leaves of the white seeded variety are sometimes chewed separately or with cubeb and sugar, as a cure for hoarseness and aphthous stomatitis. They contain glycyrrhizin and abrin. The root also yields glycyrrhizin.

Pharmacological Action :—Abrin is an intensely poisonous albumin. Doses of about 1/1000 mgm. to 1/2000 mgm. per kilogram body weight injected subcutaneously are said to be poisonous. An infusion of the bruised seeds when applied to the conjunctiva may cause fatal poisoning due to absorption of the toxic abrin through the conjunctiva. Abrin contains two fractions—a globulin and an albumose—the former being more powerful. It is a very powerful irritant and produces œdema and ecchymosis at the site of inoculation. It has little or no irritant action on the mouth and throat and is digested and rendered harmless in the stomach. One interesting phenomenon about abrin is that, when it is injected into animals in infinitesimal doses, the animal rapidly acquires immunity to the action of the poison.

Therapeutic Uses :—This plant has been used for medicinal purposes by the Hindus from very early times and Ayurvedic works like 'Susruta' mention it. The leaves have a sweetish taste and their juice is used as a cure for hoarseness ; it is applied to painful swellings mixed with bland oils. The root

is sometimes used as a substitute for liquorice but it is a poor substitute.

Abrin or an infusion of the decorticated seeds of jequirity has been used as an irritant to the eye in cases of granular lids and for corneal opacities. It causes an acute inflammation which improves the condition in some cases, but it must be regarded as an exceedingly dangerous remedy, as the inflammation is entirely beyond control. In animals the eye is often completely destroyed by the application of abrin. In modern medicine, abrin is no longer used.

References :—

(1) Warden, 1882, *Amer. Jour. Pharm.*, Vol. 54, p. 251; (2) Martin, 1887, *Proc. Roy. Soc.*, Vol. 42, p. 331; (3) Martin, 1888, *Pharm. Journ.*, p. 234; (4) Martin, 1889, *Pharm. Journ.*, p. 197; (5) Hooper, 1894, *Pharm. Journ.*, p. 937; (6) Wienhaus, 1909, *Biochem. Ztschr.*, Vol. 18, p. 228.

ACORUS CALAMUS (N.O. Aroideæ)

The Sweet Flag

VERN.—Hind. & Beng.—*Bach, Gora-bach* ; Guj.—*Vekhand* ; Tam.—*Vashambu* ; Tel.—*Vasa.*

It is a semi-aquatic perennial with indefinitely branched rhizome. It is really a native of Europe and North America but is cultivated in damp marshy places in India and Burma at an altitude of 3,000 to 6,000 feet. It is exceedingly common in Manipur and the Naga Hills, and has established itself on the edges of lakes and streams. The long creeping horizontal rhizomes are collected in the autumn, are cut into pieces and after drying are used medicinally.

Chemical Composition :—The dried rhizome yields 1.5 per cent. of a neutral, yellow, aromatic, essential oil having an agreeable odour. The fresh aerial parts yield about 0.123 per cent. of the volatile oil; the unpeeled roots, however, give a much better yield from 1.5 to 3.5 per cent. The chief constituent of this valuable oil is asaryl-aldehyde. There is also a bitter glucoside named acorin and certain other substances, such as eugenol, asarone, pinene and camphene are present. Besides these, the drug contains an abundance of starch and a little of

tannin. The oil obtained from the Indian *Acorus calamus* was studied by Rao, Sudborough and Watson (1925). They found that this oil does not contain the lower boiling constituents such as pinene, camphene, etc., in the commercial oil from Europe.

The properties of the Indian oil have been found as follows :—Specific gravity, 1.069 at 15°; optical rotation +6.2°; saponification value, 5.1; saponification value after acetylation, 16.6; acid value, 1.4.

Therapeutic Uses :—The rhizome is emetic, nauseant, antispasmodic and carminative. In doses of 35 to 40 grains it produces a violent and persistent emesis. It has an expectorant action due to the presence of the essential oil and is used as a remedy for asthma. The drug is a very old remedy for chronic diarrhœa and forms part of a number of mixtures used in the Hindu medicine. Evers (1875) tried it in chronic dysentery with good results. Henry and Brown (1923) tested it and came to the conclusion that whatever action it had was due to the presence of tannins. Chemically, there is no other constituent which might be held responsible for its astringent action.

References :—

(1) *British Pharmaceutical Codex*, 1923; (2) Rao, Sudborough and Watson, 1925, *Jour Ind. Inst. Sci.*, Vol. 8A, p. 144; (3) Henry and Brown, 1923, *Trans. Roy. Soc. Trop. Med. and Hyg.*, Vol. XVII, p. 378.

ADHATODA VASICA (N.O. Acanthaceæ)

Malabar Nut tree

VERN.—Sans.—*Vasaka*; Hind.—*Arusha, Bansa*; Beng.—*Bakash, Vasaka*; Guj.—*Adulso, Bansa*; Punj.—*Bhekkar*; Tam.—*Adhatodai.*

Adhatoda vasica is a small evergreen sub-herbaceous bush which grows all over the plains of India and in the lower Himalayan ranges ascending to a height of about 4,000 feet above the sea-level. In Sanskrit it has many names 'arusak' (not angry), 'vansa' (giving perfume), 'vrisha' (chief), 'sinha mukhi' (lion mouthed). The plant has minutely pubescent entire leaves arising from swollen nodes; the flowers are white or purple in colour. It is well-known to the people throughout the country and a yellow dye is commonly obtained from its leaves. The

leaves, the roots and the flowers are extensively used in indigenous medicine as a remedy for cold, cough, bronchitis and asthma. It is often given in the form of juice extracted from the leaves, mixed up with ginger or honey, in doses of ½ to 1 ounce. A decoction is also made from the leaves and dried leaves are administered in powder form in doses of 30 grains. Both the decoction and powder form constituents of many preparations used in the Ayurvedic medicine for various affections of the respiratory tract. In chronic bronchitis and asthma it is said to be specially efficacious. For the latter disease the dried leaves are made into cigarettes and are smoked. U. C. Dutt says, "the medicine was considered so serviceable in phthisis that it was said, no man suffering from this disease need despair as long as Vasaka plant exists." The juice of the leaves is used in diarrhœa and dysentery in Southern India and the powdered leaves are used in malarial fevers. In Burma and in Northern India the leaves are applied locally in the form of a poultice on rheumatic joints, inflammatory swellings and in neuralgias. The leaves are said to be toxic to all forms of lower life, prevent the growth of lower aquatics and check the development of parasitic vegetation. According to Watt, the alcoholic extract of the leaves is poisonous to flies, fleas, mosquitoes, centipedes and other insects. From the above remarks it will be seen that the plant is popularly believed to have remarkable medicinal properties.

Chemical Composition:—As long ago as 1888, Hooper published details of chemical analysis of the drug carried out by himself. He found that an odorous volatile principle probably of the nature of an essential oil and a non-volatile body of the nature of an alkaloid called *vasicine* were present. Hooper's work was confirmed by Boorsma of Java, who further investigated the alkaloid and tested its physiological properties but it has not been possible to find any record of this work. A thorough analysis of the drug was made and sufficient quantities of the alkaloid were obtained to determine its pharmacological action. We could not, however, collect a sufficient quantity of the essential oil to test its physical, chemical and physiological properties.

The alkaloid is found in the leaves to the extent of 0.25 per cent. The base occurs as needle-shaped crystals and has a melting point of 182°C. It is easily soluble in alcohol, is slightly soluble in cold water

but more so in hot water. A 2.0 per cent. solution in chloroform is optically inactive. Vasicine hydrochloride occurs in light, cream-coloured crystals, has a melting point of 180°C and is very soluble in water. Vasicine tartrate was also prepared and is a soluble salt. The molecular weight of vasicine was determined and found to be 188 which agrees with the empirical formula $C_{11}H_{12}N_2O$ found by analysis.

Pharmacology of Vasicine:—The alkaloid vasicine and its salts are not very toxic to undifferentiated protoplasm. They have little or no effect on the free living protozoa such as *Paramæcium caudatum* nor have they any toxic or inhibitory effect on the cultures and growth of streptococci, staphylococci, *B. coli*, *B. diphtheriæ* or *B. tuberculosis*. It is possible that the antiseptic properties of the leaves recorded by previous observers may be due to the volatile principle. Solutions of concentrations of 1 to 5 per cent. are not irritant to the mucous membrane. The alkaloid has a bitter taste but has no marked effect on the movements of the alimentary canal. In high concentrations (1 in 20,000) the peristaltic movements of the isolated gut are inhibited, probably owing to depression of the vagal endings. Intravenous injections in animals produce a slight fall of blood pressure due partly to direct depressing effect on the cardiac muscle and partly to depression of the terminations of the vagi in the heart. There is no effect on the blood vessels.

In the lungs of experimental animals the alkaloid, when given intravenously, produces a slight but a persistent broncho-dilatation. This action is in all probability due to depression of the vagal terminals in the bronchi as it is absent with small doses of pilocarpine. After administration of atropine, the broncho-dilator effect is more pronounced. The drug has a well-marked expectorant action and it is probable that the essential oil plays an important part in this direction.

Therapeutic Uses:—Clinically, an alcoholic extract made from fresh and dry Adhatoda leaves was given an extensive trial in the Carmichael Hospital for Tropical Diseases. Previously a tincture made from the leaves was tried in various civil hospitals and dispensaries in different parts of India at the instance of the Indigenous Drugs Committee. Most of the evidence produced showed that the drug has a definite expectorant action. In acute bronchitis it was found always to afford relief, especially where the sputum was thick and tenacious, acting in very much the same way as ipecacuanha. In chronic bronchitis the cough is relieved and the sputum is liquefied so that it is brought up more easily. The depression of the vagal terminations further

relieves irritation and spasm of the bronchioles. The extract was also tried in a number of cases of bronchial asthma but relief afforded by it was not marked. As the animal experiments pointed to synergistic action of atropine and vasicine a combination of the extract with belladonna preparations was tried in cases of asthma of vagotonic origin but the results were not very satisfactory.

As regards the effect of the drug in tuberculosis of the lungs the author's conclusions are also in accord with those of the Indigenous Drugs Committee. The drug is absolutely useless in curing or preventing the progress of this disease in experimental animals or human beings. There is no doubt, however, that it relieves the irritable cough by its soothing action on the nerves and by liquefying the sputum which makes expectoration easier.

Summary :—Chemical analysis of *Adhatoda vasica* shows the presence of two active principles: (*a*) an alkaloid *vasicine* whose empirical formula we have found to be $C_{11}H_{12}N_2O$ of molecular weight 188, (*b*) traces of a volatile principle of the nature of an essential oil. Vasicine has no marked action on the alimentary canal or on the circulation. It produces slight but persistent broncho-dilatation in experimental animals and this effect is considerably increased after administration of atropine. The essential oil present in the leaves appears to be chiefly responsible for the expectorant action of the drug. Clinically, the fluid extract prepared from the leaves has well-marked expectorant properties, it relieves cough, liquefies sputum which is then coughed up more readily. It is not effective in relieving attack of bronchial asthma. In pulmonary tuberculosis it has no action whatever.

References :—

(1) Hooper, 1888, *Pharm. Journ.*, Vol. 18, p. 841; (2) Chopra and Ghosh, 1925, *Ind. Jour. Med. Res.*, Vol. XIII, p. 205; (3) Sen and Ghosh, 1925, *Jour. Ind. Chem. Soc.*, Vol. I, p. 315; (4) De and Roy, 1927, *Jour. Ind. Chem. Soc.*, Vol. IV, p. 541.

ÆGLE MARMELOS (N.O. Rutaceæ)

Bael Fruit

VERN.—Sans.—*Sriphal, Bilva* ; Hind. & Beng.—*Bael* ; Guj.—*Bilinu-phal* ; Tam.—*Vilva-pazham* ; Tel.—*Bilva-pandu*.

The tree is indigenous to India and is found wild all over the Sub-Himalayan forests, in Bengal, in Central and South India and in Burma. It is also cultivated to a great extent. It is held sacred by the Hindus and its leaves, which are ternate, are presented to God Siva as offerings by the devotees. It is often planted near the temples. The Hindus consider it an emblem of fertility and a very auspicious plant. In the Hindu medicine different parts of the bael tree are used. The root bark is used in the form of a decoction as a remedy in hypochondriasis, melancholia, intermittent fever and palpitation of the heart. It constitutes an ingredient in the 'Dasamul' or ten roots used by the Hindu physicians. The leaves are made into a poultice and applied to inflamed parts. The fresh juice is bitter and pungent, and when diluted with water is praised as a remedy in catarrh and feverishness. The fruit, both green and ripe is used against diarrhœa and intestinal conditions. For diarrhœa and dysentery the roasted or sun-dried unripe fruit cut in slices is generally used. The astringent rind of the ripe fruit is employed in dyeing and tanning and it is also used medicinally. No drug has been longer and better known nor more appreciated by the inhabitants of India than the bael fruit. Two kinds of fruit are available in the market—a small and wild variety and a large cultivated variety. The full-grown fruit of either variety, when it just begins to ripen, is best for medicinal purposes:—

(1) The unripe or half-ripe fruit is regarded as an astringent, digestive, stomachic and is said to be an excellent remedy for diarrhœa owing to the presence of tannins or mucilaginous substances. It is said to be particularly useful in chronic diarrhœas. It is sometimes used in combination with opium by the Ayurvedic practitioners. The fruit is also

sliced and a confiture made from it is largely used by the Hindu physicians in the treatment of diarrhœas and dysenteries.

(2) The ripe fruit is sweet, aromatic and cooling. When taken fresh it possesses laxative properties. The dried pulp is pale orange or flesh-coloured and when mixed with water yields a pleasant orange-coloured 'sherbet' which has mild astringent properties.

Chemical Composition:—According to some authorities, bael contains tannic acid, a volatile oil, a bitter principle and a balsamic principle resembling balsam of Peru. These findings have, however, been criticised by Flückiger and Hanbury who are of opinion that the dry pulp of the fruit contains chiefly mucilage and probably pectin. They could not find any appreciable quantity of tannin to account for the astringent properties so often ascribed to the drug. Henry and Brown (1924) examined the fruit along with a number of reputed antidysenteric remedies. The dried pulp was exhausted with boiling alcohol, the extract concentrated *in vacuo* and the thick syrup diluted with water to precipitate fatty and resinous matters. The liquor from this precipitate, after concentration *in vacuo* to remove all alcohol, was tested by them on a free living ciliate protozoon, Glaucoma. The solution was found to be markedly toxic to glaucoma but owing to the large amount of gum present it proved difficult to get a satisfactory preparation of the tannins of the plant but even in the impure form these appeared to be fairly active. They came to the conclusion that the drug may owe its activity to the tannins that are present since these are toxic to Glaucoma.

A more recent work is that of Dutt and Dikshit (1930). The roots, seeds, bark, leaves and fruits were extracted with various solvents and the composition determined in each case. The roots, leaves and bark were found to contain reducing sugars and tannin mainly. The fruit pulp yielded, in addition to the usual substances, a body which has been named *marmelosin*. This is considered to be one of the most important active principles of the fruit. The seeds, when crushed and extracted with petroleum ether, gave a light yellow oil which has been found to possess very good purgative properties when taken internally in doses of 1.5 gm.

Therapeutic Uses:—Bael is believed to be an invaluable remedy in obstinate cases of chronic diarrhœa and dysentery, where there is no fever, and is given either in the form of a powder or in the form of a confection. It was so commonly used by the Western practitioners in India in old days that it found its way into the British Pharmacopœia. The three pre-

parations commonly used were :—(1) Extract of bael made from fresh unripe fruit given in half to one drachm doses several times a day, (2) liquid extract of bael prepared from dried slices of unripe fruit prescribed in doses of one to two drachms, (3) powdered dried pulp kept in airtight bottles given in doses of half to one drachm.

There is hardly any literature of recent date on the use of the bael fruit in amœbic dysentery. It appears to have little or no effect in acute dysentery when there is definite tenesmus and discharge of blood and mucus though the powdered drug is specially recommended for this condition. The beneficial effects of the bael fruit is, however, most evident when the condition has become subacute or chronic. After its administration in these conditions, the blood gradually disappears and the stools assume a more fœculent and solid form. If bael is continued for sometime, the mucus is also decreased *and may disappear. It is very useful in patients suffering from* chronic dysenteric condition characterised by alternate diarrhœa and constipation. Claims have also been made that it relieves flatulent colic in patients suffering from a condition of chronic gastro-intestinal catarrh. In the after treatment of bacillary dysentery, bael is a useful adjuvant. According to Acton and Knowles (1927) the chief trouble with such patients, as a rule, is constipation which if not relieved does not allow the ulcerated surfaces to heal firmly. Bael 'sherbet' is a useful addition to the dietary at this stage and acts chiefly as a demulcent. The pulp of the fresh fruit may be mixed with sugar and cream or with curds or made into a 'sherbet' by straining it through a piece of muslin to remove seeds and mucilage. In cases of sprue also, the bael fruit has been spoken of highly by Manson-Bahr. In many patients, especially those in the pre-sprue or early stages of the disease, it is undoubtedly helpful. The fresh fruit is best taken raw mixed with sugar though dried fruit has also been recommended.

Summary :—Bael fruit has been used in the indigenous medicine for a very long time and it had such a great reputation in the treatment of diarrhœas and dysenteries that it was made official in the British Pharmacopœia. Besides tannins,

no other active principle of any importance have so far been discovered. It has very little beneficial action in acute dysenteries but in chronic cases it relieves symptoms on account of the presence of large quantities of mucilage which acts as a demulcent. It does not appear to have any specific effect in either amœbic or bacillary dysentery.

References :—

(1) Henry & Brown, 1923, *Trans. Royal. Soc. Trop. Med. and Hyg.*, Vol. XVII, p. 378, (2) Acton & Knowles, 1927, *Dysenteries in India*. Thacker, Spink & Co., (3) Dikshit & Dutt, 1930, *Jour. Ind. Chem. Soc.*, Vol. VII, p. 759.

ALANGIUM LAMARCKII (N.O. Cornaceæ)

VERN.—Sans.—*Ankola* ; Hind.—*Akola, Dhera* ; Beng.—*Akarkanta* ; Bomb.—*Ankola* ; Guj.—*Onkla* ; Tam.—*Alangi* ; Tel.—*Uduga-chettu, Kudagu.*

It is a deciduous shrub or small tree met with in forests throughout India and Burma. The root bark is used in indigenous medicine as an anthelmintic and purgative. It has also a reputation in leprosy and skin diseases. Dr. Mohideen Sheriff found it to be an efficient emetic in 45 to 50 grain doses and a good febrifuge in 2 to 5 grain doses.

Chemical Composition :—A preliminary assay of the bark showed the presence of about 0.82 per cent. of an alkaloid on the air-dried material. Systematic chemical examination gave the following results :—(*a*) Petroleum ether extract (B.P. 35° to 70°), 0.40 per cent., (*b*) Absolute ether, 0.66 per cent.; (*c*) Absolute alcohol, 4.01 per cent.; (*d*) Alcohol (70 per cent.), 3.5 per cent

Detailed chemical study revealed the presence of an alkaloid and a fair amount of potassium chloride but no tannins or glucosides. The base was purified to a great extent but all attempts to prepare a crystalline salt have thus far been frustrated. The sulphate of the base was obtained as a white powder which was found to be hygroscopic and had a tendency to turn yellow on keeping.

Pharmacological Action :—The pharmacological action of the sulphate of the active principle of *Alangium lamarckii* has been studied in the department of Pharmacology, Calcutta School of Tropical Medicine. In doses of 4 to 5 mgm. per kilo body weight, administered intravenously in cats, alangine

sulphate produces a sharp fall of blood pressure of about 30 to 40 mm. This fall is only temporary and within 1 to 2 minutes the blood pressure returns to the normal level. The auricles and the ventricles are dilated and the strength of the heart beats is reduced. The depression of the heart is also noticed in isolated perfused mammalian hearts. Respiration becomes irregular. The tone and the peristaltic movements of the intestines are increased and there is an increase in the volumes of the intestines, the spleen and the kidney. Detailed study of the pharmacology is being carried on.

Therapeutic Uses:—The claims made regarding the therapeutic efficacy of the drug have not been investigated recently by any worker. The laboratory study of the action of the drug has been completed.

ALLIUM SATIVUM (N.O. Liliaceæ)

Garlic

VERN.—Sans.—*Lasuna*; Hind.—*Lasan*; Beng.—*Rasun*; Tam.—*Vallai pûndu*; Tel.—*Vellulli tella-gadda.*

Garlic is very commonly found all over India. Not only does it grow wild, but is also extensively cultivated on account of its use as a spice. As a medicine, garlic was held in great repute by the ancient physicians of India. It is considered to be hot and stimulant, and is administered in fevers, coughs and other debilitating conditions. It has also a reputation as a febrifuge in intermittent fevers. Externally, the juice is used as a rubefacient in skin diseases and as ear drops in ear-ache and deafness. It has also been used to a fairly large extent in Western medicine.

Chemical Composition:—The active principle of garlic is a volatile oil which may be readily obtained by distilling the bruised bulbs. The oil is a clear limpid liquid of a dark brown or yellow colour; it has an intense garlic odour and the yield is from 0.06 to 0.1 per cent. Its specific gravity at 14.5° is 1.0525 and it is optically inactive. When purified it is colourless and can be distilled without decomposition. With some samples, even at winter temperature, the oil becomes semi-solid through the deposition of fine crystals. Semmler found

that the oil decomposes when heated to 150°C. Fractionated under 16 mm. pressure, four different fractions were obtained :—

Fraction I (6 per cent.) consists of allyl propyl disulphide. It has the odour of onions and gives a voluminous precipitate with mercuric chloride.

Fraction II (60 per cent.) consists of diallyl disulphide which has the odour of garlic. It is rendered colourless by distilling with a little potassium.

Fraction III (20 per cent.) boils between 112° to 122°C at 16 mm. pressure.

Fraction IV (10.5 per cent.) boils above 122° at 16 mm. pressure and decomposes on further distillation. It consists mainly of polysulphides.

It will thus be seen that garlic does not contain any allyl sulphide in any of the different fractions obtained by distillation. Allyl sulphide was previously thought to be the chief constituent.

THERAPEUTIC USES :—*External Application.*—Garlic juice has been employed as an antiseptic in ulcerated surfaces and wounds with satisfactory results. Garlic juice mixed with 3 or 4 parts of ordinary or distilled water (succus allii) has been used as a lotion for washing the wounds and foul ulcers. Definite improvement in the condition of infected wounds was noticed within 24 hours after washing with this lotion and a very marked and decided improvement within 48 hours. Not only was the purulent discharge markedly decreased but the pain was also considerably relieved and in some cases it entirely disappeared. No injury to the tissues could be noticed as a result of application of this solution. Though the carbolic acid co-efficient of this solution was found to be rather lower than other antiseptics (Rideal-Walker co-efficient=2), it possesses the distinct advantage of being much less irritant to the tissues than carbolic acid. Whereas it is seldom possible to use carbolic acid lotion in a greater strength than 1 in 40 (2½ per cent.) the succus allii can be employed in a strength of 20 to 25 per cent. without apparent injury to the tissues. Minchin (1916) states that he has used allium preparations in the treatment of suppurating wounds and foul ulcers for 15 years and obtained very satisfactory results.

Internal Administration :—Garlic is an excellent medicine in several forms of atonic dyspepsia. Succus allii has been administered in 10 to 30 minim doses in several cases of flatu-

lence and colic and good results have been reported. The essential oil of garlic is absorbed into the circulation and is excreted through the lungs and bronchial mucosa acting as a good antiseptic and antispasmodic. Lamb (1925) recommends garlic in the form of tinct. allii, either alone or in combination with the usual expectorant mixtures. When there is much gastro-intestinal catarrh, garlic in the form of an ointment is rubbed on the abdomen, a binder being applied afterwards. It is said to be very effective in bronchial and asthmatic complaints. According to Minchin (1916) garlic is a remedy for many diseased conditions. He considers it as a prophylactic for typhus, typhoid and diphtheria. He advises in the first two diseases the trial of 1 drachm of succus allii sativi every four to six hours, given in beef tea or with syrup. For a child under twelve, ½ drachm in syrup is sufficient. Given early in typhoid fever it will almost abort the disease, and its action as an intestinal antiseptic makes it valuable at any stage of the disease. In diphtheria the constant application obtained by chewing a 'clove' of garlic removes the membranes, reduces temperature and relieves the patient. About 1 or 2 oz. of garlic can be used in this way in three or four hours. For a week after the membrane disappears, 1 or 2 oz. of the bulb should be chewed daily. The diphtheritic patient has no taste or smell, and merely finds the garlic hot. Used in an inhaler three to four hours daily the succus rapidly relieves the distressing features of whooping cough. For young infants and children 20 to 30 minims of the succus in syrup every four hours gives rapid relief in early cases.

Crossman (1918) thinks that garlic, if given in sufficient doses, is an invaluable remedy in the treatment of pneumonia. He used it for 2 years in the treatment of lobar pneumonia and, according to his published report, in no instance has it failed to bring the temperature, pulse and respiration down to normal in about 48 hours. In no case was the crisis deferred beyond the 5th day of the disease. He chiefly used tinct. allii made from garlic bulbs (strength 1 in 5) and gave it in doses of half a drachm of the drug in water every 4 hours. The results in other bronchial infections, *e.g.*, bronchitis,

bronchiectasis, fœtid bronchitis and influenza, were no less promising.

In pulmonary phthisis, garlic and its preparations have been used very extensively. There are several proprietary preparations on the market at the present moment which contain either the juice of garlic or its constituents. In tubercular affections of the lungs, garlic juice often diminishes the obstinate cough and expectoration. The appetite is improved and in some cases night sweats are also known to subside completely. As a result of the sensation of well-being and comfort produced, sleep is induced and digestion improves resulting in gain in weight. Minchin (1916) warmly advocates the use of garlic preparations in tuberculous affections. According to him, allyl sulphide can be used in all tuberculous lesions in accessible situations or in those which can be rendered accessible. He has treated a number of cases of tuberculosis of the larynx in man by ½ to 1 drachm doses of the juice 2 to 3 times a day and has always obtained very good results.

From the satisfactory clinical results, further studies are called for.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Minchin, 1916, *Med. Press and Circ.*, June 13; (3) Crossman, 1918, quoted in *Medical Annual*, 1918; (4) Lamb, 1925, *Clinical Journ.*, Vol. LIV, p. 275.

ALPINIA GALANGA (N.O. Citamineæ)

The Greater Galangal

VERN.—Sans.—*Kulinjana, Dumparastma* ; Hind.—*Kulanjan* ; Beng.—*Kulinjan* ; Mar.—*Kosht-kulinjan* ; Tam.—*Pera-rattai* ; Tel.—*Pedda-dumpa-rash-trakam* ; Pers.—*Khus-raveduruc-kalan* ; Arab.—*Khulanjan-e-kabir, Khulanjane-qasbi.*

It is a perennial plant found in East Bengal and South India. It is a native of Sumatra and Java but is now completely naturalised in many parts of India. The plant has a reputation in the indigenous system of medicine and is fairly largely used in Southern India. In Mysore, it is a domestic

medicine and is much used by old people with bronchial catarrh. The rhizomes are useful in rheumatism and catarrhal affections. The tubers and seeds are said to possess carminative properties and are used as a fragrant adjunct to complex prescriptions. In the Mohammedan medicine, it is considered to be a good remedy for impotence and nervous debility.

Chemical Composition:—The constituents of Galanga root have been isolated by Jahns (Kirtikar and Basu). He found three different compounds, campheride, galangin, and alpinin. No detailed chemical work has recently been done to confirm these findings. From the green rhizomes, a pale yellow oil with a pleasant odour can be obtained on distillation. This oil contains 48 per cent. of methyl cinnamate, 20 to 30 per cent. of cineole, camphor and probably d-pinene.

The pharmacology of this drug was studied by N. T. S. Yajolu in the Department of Pharmacology of Vizagapatam Medical College (unpublished).

Pharmacological Action:—Intravenous injections of small doses of a tincture or an infusion of *A. galanga*, produce a sharp fall in blood pressure in experimental animals. The blood pressure, however, comes to normal in a short time. The fall in blood pressure is accompanied by a rise in the volume of the intra-abdominal organs like the spleen and the intestines showing that dilatation of the splanchnic blood vessels is one of the causes of the fall of blood pressure. The contractions of both the auricle and the ventricle are lessened showing that the drug has a depressant action on the heart. Dilatation of the peripheral blood vessels is observed when they are perfused with physiological saline solutions containing various concentrations of the drug. The drug is a depressant to the cardio-vascular system.

Respirations in experimental animals are stimulated in small doses but depressed with larger ones, the respiratory centre being paralysed. The important action of the drug is, however, on the bronchioles. Even small doses produce a dilatation of the bronchioles and this effect is much more pronounced when the dose is increased. Asthma-like conditions produced artificially in animals by administering pilocarpine are immediately relieved by small doses of the tincture of *A. galanga*.

The drug has no marked action on other systems of the body. The secretion of urine is slightly diminished, but this effect appears to be vascular, for the rate of secretion comes to normal as soon as the blood pressure comes to normal. The isolated uterus is relaxed and its contractions become regular. The action on the gastro-intestinal tract is similar to that produced by other essential oils.

Therapeutic Uses:—As a volatile oil is one of the important constituents of the drug, suggestions have been made to try it for the same purposes as the other volatile oils, *e.g.*, as a

carminative. The drug has a slight irritant action on the mucous membrane of the stomach and this may be used in producing a reflex increase in the bronchial secretion. As the oil is excreted through the lungs it acts as an expectorant. It appears, therefore, that the popular use of the drug as a remedy for many respiratory ailments is justified. Vajolu found that administration of a paste of *A. galanga* in honey lessened the paroxysms of cough in children suffering from whooping cough. He also found that in young children suffering from bronchitis administration of this drug relieved the distressing symptoms and also had a favourable action on the temperature of the patients. The drug, therefore, promises to be of use in respiratory troubles especially those of children. The antispasmodic action of the drug may also prove useful in conditions like asthma.

In affections of the gastro-intestinal tract the drug can be used like other volatile oils. It has got the advantage of having a very pleasant odour and thus may be used in cough and digestive mixtures. It has been suggested that it may be useful in intestinal and biliary colic.

References :—

Schimmel. Ber., 1910, Oct., 138; 1911, April, 19.

ALSTONIA SCHOLARIS (N.O. Apocynaceæ)

Dita bark

VERN.—Sans.—*Sapta-parna* ; Hind.—*Chhatian, Datyuni* ; Beng.—*Chhatim* ; Tel.—*Edakula pala.*

Alastonia scholaris is a tall evergreen tree widely cultivated throughout India and found in the Sub-Himalayan tract from the Jumna eastward ascending to 3,000 ft. The tree is also found in abundance in Bengal and Southern India. The bark of the tree has been reputed in the Hindu medicine for ages as a tonic, alterative, useful in fever and skin diseases. Another allied species, *A. constricta*, does not appear to grow in India.

Chemical Composition :—An uncrystallisable bitter principle called 'ditain' was isolated long ago. To this was ascribed the febrifuge properties of the drug. Later investigations showed that the constituents of the bark were :—(1) An alkaloid *ditamine,* (2) a substance

resembling an alkaloid, (3) a crystallisable acid and (4) a fatty acid and fatty resinous substances. Bacon (1906) found that the bark contains two alkaloids—*ditamine* and *echitamine*. Ditamine can be separated from its solutions by making them alkaline with sodium bicarbonate and extracting with ether ; echitamine is obtained by making the solution strongly alkaline with NaOH and extracting with chloroform.

Pharmacological Action :—Bacon studied the action of the alkaloid echitamine in the Philippines. He found that it is not a protoplasmic poison. Amœbae suspended in a 1 per cent. solution of echitamine hydrochloride seem to thrive ; there is no decrease in their motility even after exposure for 2 hours. The use of 'dita' extract in place of quinine for malaria and for amœbic dysentery would thus seem to be of doubtful value.

Therapeutic Uses :—The fame of 'dita' as a healing agent dates from great antiquity. It was at one time thought to be very useful in malaria and other fevers, so much so that it was stated that equal doses of ditamine and sulphate of quinine would have the same medicinal effects. In the Manilla Hospital, the results of trials obtained in malaria were very satisfactory and it was reported that it would completely replace quinine in malignant tertian fevers. The drug was tried in India at the instance of the Indigenous Drugs Committee. It was administered to 14 cases of malaria, in all of which it caused the temperature to fall steadily to normal in a short time. No perspiration and over-exhaustion of the patient were induced. Treatment for a few days only was sufficient to cure the patient. No definite pathological and hæmatological findings are recorded in these cases to warrant any definite conclusion as to its real antimalarial properties. Goodson, Henry and Macfie (1930) tried the alkaloids of both *A. scholaris* and *A. constricta* in bird malaria. The former contains the alkaloid echitamine, which produces only slight action even in doses of 5 mgm.

Alstonia scholaris is reputed to be a valuable remedy in chronic diarrhœa and in advanced stages of dysentery. The report of the Indigenous Drugs Committee states that the drug seems to produce good effects in cases where the catarrhal conditions of the mucous membrane of the intestines have lasted for some time. It does not seem to produce any marked effect in ordinary diarrhœa. A tincture prepared by the Medical

Stores Depot at the recommendation of the Indigenous Drugs Committee was tried clinically in three cases of dysentery in the jail. No good effects were noticeable from one drachm doses, 3 times a day, in any of the cases.

References :—

(1) Bacon, R. F., 1906, *The Philippine Journal of Science*, Vol. I, No. 10, December, p. 1007; (2) *Report, Indigenous Drugs Committee*, 1921; (3) Goodson, J. A., Henry, T. A., and Macfie, J. W. S., 1930, *Biochemical Journal*, Vol. XXIV, No. 4, pp. 874-890.

ANDROGRAPHIS PANICULATA (N.O. Acanthaceæ)

The Creat

VERN.—Sans.—*Kirata, Bhunimba*; Hind.—*Kiryát, Mahálítá*; Beng.—*Kalmegh, Mahátítá*; Mar.—*Olenkiráyat*; Guj.—*Kiryáto, Olikiryát*; Tam.—*Nila-vémbu, Shiral-kuchchi*; Arab.—*Qasabuzzarirah*.

It is an annual plant, 1-3 feet high, common in hedge-rows throughout the plains of India from Lucknow to Assam. It is also cultivated in gardens in some parts of India. The shrub is well-known under the name of 'kalmegh' and forms the principal ingredient of a household medicine called 'alui' which is extensively used in Bengal. The macerated leaves and juice together with certain spices are made into little globules, which are prescribed for infants to relieve griping, irregular stools and loss of appetite. The roots and leaves have also the reputation of being a febrifuge, tonic, alterative and anthelmintic. In general debility, dysentery and certain forms of dyspepsia associated with gaseous distension of the bowels, the decoction or infusion of the leaves have been used with satisfactory results.

Chemical Composition :—Dymock and his co-workers found that an aqueous infusion of the herb was intensely bitter and acid and thought that the bitterness was due to an indifferent, non-basic principle. No alkaloid could be isolated but the ash contained a large quantity of potassium salts. Gorter (1911) thought that the bitter substance in the leaves was a lactone 'andrographolid' of the formula $C_{20}H_{30}O_5$. Later investigations by Bhaduri (1914) showed that the leaves contained two bitter substances and traces of an essential oil. The first bitter principle obtained as intensely bitter yellow crystals with formula $C_{19}H_{28}O_5$ and

M.P. 206°. It did not respond to any tests for alkaloids and glucosides. The second bitter substance was obtained in an amorphous form and was named 'kalmeghin' $C_{19}H_{31}O_5$, M.P. 185°.

Therapeutic Uses:—A preparation of this drug was sometime ago largely advertised in England as a substitute for quinine and as a general powerful tonic. This has, however, been largely discontinued as it does not seem to possess any special antimalarial property. It is an intensely bitter substance and seems to be in no way inferior to other bitters mentioned in the pharmacopœia. It is easily available and is very cheap and merits better recognition.

References :—

(1) Gorter, 1911, *Rec. Trav. Chim. Pays-Bas, 30*, 151; (2) Bhaduri, 1914, *Amer. Jour. Pharm. 86*, 349.

ANTIARIS TOXICARIA (N.O. Urticaceæ)

The Upas tree

VERN.—Mar.—*Chándla, Chándakuda, Sápsúndi* ; Tam.—*Nettavil maram* ; Can.—*Jajhugri* ; Burm.—*Hmyaseik, Myeh-seik.*

The tree has become famous since the latter part of the eighteenth century as the source of a most deadly poison. Most exaggerated statements regarding this plant were circulated by a Dutch surgeon about that period. It was stated that all living things approaching within miles of these trees fall a victim to the effects of the poison exhaled from them. These are now universally recognised to be myths and not facts. The juice derived either from the leaves or the bark of the tree is nevertheless distinctly poisonous. The sap is of a dark brown colour with a gummy consistency, bitter and biting in taste. It is used to this day as an arrow poison by the Karens in Java, Malaya and particularly in Burma where the tree is most commonly found. Its poisonous properties, however, are not widely known in the Deccan and Ceylon where also the tree is frequently met with. In the Concan and in Canara, the bitter seeds are used as a febrifuge and as a remedy in dysentery, one-third to one-half of a seed being given three times a day. In Travancore,

A. toxicaria is known as the 'sacking tree' and is not regarded by the people as poisonous; the same is the case in Coorg, where sacks and even garments are sometimes made from the inner bark.

Chemical Composition:—A large amount of work has been done on the composition of the milky juice of this plant since 1838. The latest of these, by Kiliani (1913), shows that the juice contains the following important constituents:—(1) Antiarol, $C_9H_{12}O_4$, the trimethyl ether of 1,2,3,5 phentetrol, (2) potassium nitrate, in large amounts, (3) a crystalline resin, named antiarresin, $C_{39}H_{56}O_2$, which is the cinnamyl ester of α-amyrin, (4) a crystalline protein, (5) an acid, $C_{16}H_{14}O_7$ and (6) three active glucosides (*a*) *α-antiarin*, $C_{27}H_{42}O_{10}.4H_2O$, crystalline, M.P. 220-225°, (*b*) *β-antiarin*, $C_{27}H_{38}O_{10}.3H_2O$, crystalline, M.P. 206° to 207° and (*c*) *γ-antiarin* which is amorphous. These glucosides occur in varying amounts in different samples and are said to possess strong digitalis-like action on the heart.

Pharmacological Action:—Regnault (1878) experimented with a juice supposed to have been derived from *A. toxicaria* and concluded that it was a powerful heart poison. Boinot and Hedon (1891) examined the arrow poison prepared by the Maungs of Tonking from the leaves of *A. toxicaria.* The dried latex was a dark thick plastic substance which forms an emulsion in water and normal saline, leaving behind a gummy residue. It dissolved slowly in alcohol making a white opaque solution. Three drops of a solution of 0.5 gm. of the poison in 10 gm. of water placed on a frog's heart arrested the pulsations in 7 minutes. About 10 minutes after the injection of a toxic dose of a 2 per cent. solution in a guinea-pig weighing 250 gm., the animal became very quiet and had a tendency to avoid all movements. On making it move, it dragged its hind limbs in a way that showed marked paresis. Soon after, it developed tremors of the head and was unable to raise it. Later, the front limbs lost all strength with the result that the animal lay on its abdomen with legs outstretched. Urine and fæces were expelled after some spasms and the animal died. The minimum lethal dose was found to be 1/40 grain of the actual poison in solution. A dose smaller than this produced mild symptoms but the animal recovered completely in about 8 hours. No hæmorrhages were seen anywhere in the body on post-mortem examination excepting a faint redness at the site of the injection. A solution of 0.4 gm. of the substance in 25 c.c. of absolute alcohol is opalescent; 2 c.c. of this injected into a guinea-pig produced death of the animal in 15 minutes. The remaining portion of the solution was dried and weighed. The approximate quantity of the drug in the alcoholic solution which killed the animal was found to be 0.13 gm. (1.95 grains). Two more guinea-pigs of the same weight who received 1 c.c. remained ill for about half an hour and then recovered completely. As the lethal dose calculated from the emulsion in water was 1/40

grain and in alcohol 1.95 grains, it is evident that the poisonous element is not the alcohol-soluble portion only, but something more than that. The cause of death as a result of administration of the drug in experimental animals seems to be failure of the heart. The heart is found on post-mortem examination to be contracted and in systole.

Pharmacological studies carried out recently in the School of Tropical Medicine show that the drug is a very powerful heart poison. 10 to 15 mgm. of the water-soluble fraction injected intravenously in a cat usually produces a fall of blood pressure followed quickly by death due to auricular and ventricular fibrillation. That the heart is primarily affected is shown by the fact that the cardiac failure usually precedes the failure of respiration. The alcohol-soluble fraction seems to be less potent than the watery extract. Further work is in progress.

Therapeutic Uses :—The drug has for centuries been avoided as a deadly poison and in view of recent investigations, there appears to be ample justification for the popular belief regarding its toxicity. It is, however, a potent remedy and it may be possible after more detailed study of its pharmacological properties, to regulate its dosage in such a way that it may be used as a therapeutic agent. There are many examples of potent remedies and poisons which are being used in therapeutics to the immense benefit of suffering humanity.

References :—

(1) Kiliani, H., 1896, *Archiv. Pharm.*, Vol. 234, p. 438; (2) Kiliani, H., 1910, *Ber.*, Vol. 43, p. 3574; (3) Kiliani, H., 1913, *Ber.*, Vol. 46, p. 2179; (4) Chopra, R. N., and De, P., 1932, *Ind. Jour. Med. Res.*, Vol. XX.

ARECA CATECHU (N.O. Palmaceæ)

The Areca- or Betel-nut Palm

VERN.—Sans.—*Púga-phalam, Gubak* ; Hind.—*Supari, Supyari* ; Beng.—*Gua, Supari* ; Assam—*Tambul* ; Guj.—*Sopari, Hopári* ; Tam.—*Kamugu, Pákku, Kottai-pákku.*

Areca catechu is a handsome palm with a tall, slender, graceful stem crowned by a tuft of large elegant-looking leaves. The tree is indigenous to Sunda Islands but is now extensively

cultivated in most tropical countries, especially Southern India, Assam and the Eastern Archipelago. In these parts the seeds are universally employed by the inhabitants as a masticatory. These are chewed together with lime, black catechu and the leaves of betel (*Piper betle*), and sometimes also with such articles as turmeric and tobacco leaf. The popular belief is that decay of teeth is prevented, but owing to constant irritation the mucous membrane of the mouth and gums is inflamed causing loosening and loss of teeth, and sometimes oral carcinoma.

The fruit is orange-yellow in colour when ripe and is of the shape and size of a small egg. The pericarp is fibrous resembling that of a cocoanut ; when ripe it can be separated easily from the seed. The seeds when dry are 20 to 25 mm. in diameter and bluntly conical in shape, greyish brown in colour and silvery in appearance. The surface is covered with a network of paler depressed lines. The seed is hard and heavy and has an aromatic, astringent and somewhat acrid taste.

Chemical Composition :—The first chemical analysis of the seed was performed by Bombelon in 1886 who isolated a liquid volatile alkaloid resembling nicotine to which he gave the name *arecaine*. Later, other alkaloids were isolated, the proportions of these in the seeds being *arecaine* 0.1 per cent. and *arecoline* 0.07 to 0.1 per cent.; *arecaidine, guvacoline, guvacine* and *choline* occur only in traces. All these alkaloids are chemically related; arecoline is methyl arecaidine and is prepared by esterifying arecaidine with methyl alcohol; arecaine is prepared by the action of formaldehyde and formic acid on guvacine; guvacoline can be converted into guvacine by hydrolysis. Besides these, the seed contains 15 per cent. of tannin and 14 per cent. of fat.

The most important of all the alkaloids and the one to which the sialagogue and the anthelmintic properties of the drug are attributed is arecoline, which has the formula $C_8H_{13}NO_2$. It is a colourless, oily liquid with a boiling point of 230°C. It forms crystalline salts with acids, and arecoline hydrobromide is official in several pharmacopœias in Europe. On account of the readiness with which this alkaloid is absorbed it is usually considered too dangerous to be used as a tæniacide in pure conditions and therefore the powdered nut is preferred.

Preparations :—Dry powdered seeds are given in doses of 1 to 4 drachms. Powdered fresh seeds are more powerful in doses of 2 to 4 drachms. Arecoline hydrobromide is official in the German Pharmacopœia and in the French Codex; the dose is approximately 1/20 to 1/40 grain (0.0005 to 0.0015 gm.). It is a crystalline substance and

is soluble in water. It occurs in 'tænaline' which is a liquid preparation used in veterinary medicine; dose 1 minim. for every pound weight in dogs.

Pharmacological Action :—Arecoline is a highly toxic substance. Its pharmacological action resembles that of muscarine, pelletierine and pilocarpine. It violently stimulates the peristaltic movements of the intestines and produces a marked constriction of the bronchial muscles which can be overcome by adrenaline or atropine. The terminations of the vagi in the heart are stimulated and the organ is depressed; the blood pressure falls. When dropped into the eye, a 1.0 per cent. solution constricts the pupil, like physostigmine. It is a powerful sialagogue and stimulates the secretion of sweat in the same way as pilocarpine.

Therapeutic Uses :—In India and China, areca or betel nut has been used as an anthelmintic in man and animals from time immemorial. It was considered so efficacious against tapeworms and roundworms and so highly esteemed by the people that it was introduced into the British Pharmacopœia. Barclay tried the powdered seeds in doses of 6 drachms against tapeworms with good results. Powell found betel nut and the juice of the leaves of *Piper betle* in doses of one ounce an efficient anthelmintic. He thought so highly of its anthelmintic properties that he expressed the opinion that the habit of chewing betel nut among the inhabitants of certain countries where intestinal parasites are common, is a protective habit instinctively acquired on account of its prophylactic value against these parasites. Waring, however, was of the opinion that it could hardly have any such effect, as intestinal parasites are very common among the people of India and Burma who make a habit of chewing betel nut. Chopra and Chandler (1928) believe that the chewing of betel nut and betel leaf does influence the number of hookworms harboured. This result is not, however, attributable to any anthelmintic power of the juice, which is not swallowed, but to the constant spitting which tends to eliminate the immature hookworms while making their way from the trachea to the œsophagus. The chewing of tobacco has a similar effect, and in some places is credited with anthelmintic power. Bentley (1904) and Schüffner (1912) treated a number of cases of hookworm disease with half to one ounce doses of the powdered betel nuts with little effect. Caius and Mhaskar (1924) gave

four drachms of the recently-dried seeds in the form of a powder without any preliminary preparation and without any after purgative in cases of roundworm and hookworm infections. The patients passed 1 to 3 semi-solid stools but no worms were expelled. The powdered fresh nut produced a stronger irritant effect on the intestine but no worms were expelled.

Areca nut is further credited with astringent properties and has been used with satisfactory results in the relaxed condition of the bowels which sometimes occurs in tropical climates. Large doses, *e.g.*, 6 drachms to one ounce of the powdered seeds, however, produce griping and irritation and loose motions may start as a result of such irritation.

References :—

(1) Chopra, R. N., and Chandler, A. C., 1928, *Anthelmintics and their Uses in Medical and Veterinary Practice,* The William Wilkins & Co., Baltimore; (2) Lewin, L., 1931, *Phantastica.*

ARGEMONE MEXICANA (N.O. Papaveraceæ)

Mexican Poppy

VERN.—Sans.—*Srigala kantaka* ; Hind.—*Bharbhand, Kulila* ; Beng.—*Shial kanta* ; Tam.—*Birama-dandu* ; Tel.—*Brahma-dandi-chettu.*

It is an American plant, which has become naturalised in India, and grows wild all over the country. It is a spiny herbaceous annual, found everywhere from Bengal to the Punjab, on the roadside and on waste lands. The leaves are prickly and thistle-like; the flowers have a bright yellow colour. The yellow milky juice of the plant has long been used in India as a medicine for dropsy, jaundice and cutaneous affections. An infusion of the juice was regarded by early physicians as a diuretic and was fairly extensively used. As an external application for indolent ulcers and herpetic eruptions, it was also popular. The seeds yield on expression a pale yellow clear limpid oil used in lamps and medicinally in ulcers and eruptions. The early European physicians in India used the seeds and seed-

oil as a remedy for dysentery and other intestinal affections. There has been much difference of opinion regarding the aperient action of the oil but some authorities assert that the oil in doses of 30 to 60 minims is a valuable remedy.

Chemical Composition :—In 1863 Haines examined the extract of the whole plant and was unable to find any alkaloid in it. Later investigations, however, showed that it contained *berberine* and *protopine* but no morphine or argemonine as was reported by some workers. The seeds yield about 22 per cent. of an oil—argemone oil. This oil contains up to 40 per cent. free glycerides of fatty acids. Dragendorff stated that the seeds contained an alkaloid which agrees with morphine in all its important reactions, but this statement is not borne out by recent studies. The seeds when incinerated yield an ash which is largely composed of alkaline phosphates and sulphates.

Therapeutic Uses :—As has already been stated, the oil obtained from the seeds has long been used as a purgative. Though it produces an aperient action it has no special advantage over the other purgative drugs of the pharmacopœia and hence is not used to any large extent in these days. The seeds are said to possess narcotic properties but these are not very marked.

References :—

(1) Iyer, Sudborough and Ayyar, 1925, *Jour. Indian Inst. Sci.*, Vol. 8, p. 29; (2) *Bulletin of the Imperial Institute, London*, 1922, Vol. 20, p. 292.

BALSAMODENDRON MUKUL (N.O. Burseraceæ)

Gum Gugul

VERN.—Sans.—*Guggula* ; Beng.—*Guggul, Mukul* ; Hind.—*Gúgal* ; Tam.—*Gukkal* ; Guj.—*Gúgal* ; Arab.—*Moql.*

Gugul is an oleo-gum-resin obtained from *Balsamodendron mukul*, a small tree 4 to 6 ft. high with slightly ascending branches, alternate trifoliate leaves and small brownish flowers. It is commonly found in Rajputana, Sind, Eastern Bengal and Assam.

Chemical Composition :—The chemistry of *Balsamodendron mukul* (Gum Gugul) has not been thoroughly worked out. The allied variety, *Balsamodendron myrrha (Commiphora myrrha)* which is indigenous to

North-Eastern Africa and Southern Arabia has, however, been studied. Myrrh is widely used in India and as it is a rare and costly product, it is very often adulterated with gums of *Balsamodendron mukul,* which, on account of its close resemblance to myrrh, is known as 'false myrrh' *Balsamodendron myrrha* contains 30 to 60 per cent. of gum, 27 to 50 per cent. of resin, 2.5 to 10 per cent. of an essential oil and some bitter substances. The essential oil contains cumic aldehyde, phenols like eugenol and meta-cresol, pinene, di-pentene and limonene. *Balsamodendron mukul* has probably a very similar composition though it may differ from the other variety in details.

Pharmacological Action :—The pharmacological action of this oleo-resin resembles in many ways the action of copaiba and cubebs. It has no action on the unbroken skin, but on the abraded skin and on the mucous membranes, it acts as an astringent and antiseptic. When taken internally it acts as a bitter, stomachic and carminative, stimulating the appetite and improving the digestion. It produces a sensation of warmth in the stomach and is quickly absorbed. Like all oleo-resins it causes an increase of leucocytes in the blood and stimulates phagocytosis. It is excreted by the skin, mucous membranes and the kidneys, and in the course of its excretion, it stimulates them and disinfects their secretions. It acts as a diaphoretic, stimulating expectorant and diuretic. It is also said to be a uterine stimulant and an emmenagogue, and regulates the menstrual functions. It is quite harmless and may be taken for a long time without any ill effects. It sometimes produces an erythematous rash like copaiba, and rarely symptoms of kidney irritation may appear, but these rapidly disappear when the drug is omitted.

Therapeutic Uses :—This drug has a wide range of usefulness in the indigenous medicine. It is used in form of a lotion for indolent ulcers, and as a gargle in caries of the teeth, weak and spongy gums, pyorrhœa alveolaris, chronic tonsillitis and pharyngitis and ulcerated throat. A drachm of the tincture (20 per cent. in 90 per cent. alcohol) in 10 ounces of water makes a useful lotion and gargle. It is used as a stomachic in chronic dyspepsia with dilatation and atony of the walls of the stomach. Troublesome borborygmi are often relieved by the use of this oleo-resin. As an intestinal disinfectant it is used in chronic catarrh of the bowels, diarrhœa, chronic colitis, tubercular ulceration of the bowels and diarrhœa. It is believed to stimulate the appetite, improves the general condition, reduces fever, causes absorp-

tion of effused products and reduces secretion from diseased surfaces. In pulmonary tuberculosis it stimulates expectoration, and lessens and disinfects the sputum. In pleural effusions and in ascites of tubercular peritonitis it is said to be of great value. In marasmus of children it is said to be of value and is also used in anæmia, neurasthenia, debility and allied conditions. It is believed to be a valuable aphrodisiac. Gugul is said to have marked antisuppurative properties. Given in large doses every four or six hours it is believed to be useful in laryngitis, bronchitis, pneumonia and whooping cough. It is often combined with salicylate of sodium. It is said to improve the general condition of the patient in leprosy, relieves lassitude, gives a sense of well-being, and relieves the nervous pains that are so very common in this disease. In pyelitis, cystitis, and gonorrhœa it is useful after acute symptoms have subsided. In chronic endometritis, amenorrhœa, and menorrhagia it is particularly valued. Administered in large doses it is said to be useful in leucorrhœa.

Inhalations of the fumes of burnt gugul are given in hay fever, acute and chronic nasal catarrh, chronic laryngitis, chronic bronchitis, and phthisis.

The beneficial effects of the drug in many of these conditions can be explained by the presence of the oleo-resin which contains active aromatic substances.

References :—

(1) Finnemore, 1926, *The Essential Oils;* (2) Roberts, 1931, *Vegetable Materia Medica of India and Ceylon.*

BASSIA LATIFOLIA (N.O. Sapotaceæ)

The Mahua tree

VERN.—Sans.—*Madhuka* ; Hind.—*Mahuá, Mhowa, Jangli-mohá* ; Beng.—*Maua* ; Tam.—*Kat illipi* ; Tel.—*Ippa, Eppi* ; Pers.—*Durakhte-gulchakáne-sahrai.*

BASSIA LONGIFOLIA (N.O. Sapotaceæ)

VERN.—Sans.—*Madhuka* ; Hind.—*Mohua* ; Sing.—*Mee* ; Tam.—*Illupai, Iluppai* ; Tel.—*Ippi.*

Bassia latifolia is a large deciduous tree, indigenous to the forests of the Central Provinces. It is cultivated all over India and is particularly plentiful in the Central Provinces and the Bombay Presidency. It thrives on dry, stony ground and bears

clusters of yellowish-white fleshy flowers. The fruits are green when unripe, and reddish yellow or orange when ripe. The tree is valued for its flowers, its fruits, its seeds and its timber and is of considerable economic importance. *Bassia longifolia* is another tree of the same natural order possessing practically the same properties. This is a large much-branched tree with a slightly furrowed bark, linear lanceolate glabrous leaves, small fleshy flowers and ovoid fruits. It is entirely a South Indian plant and is commonly grown in Mysore, Malabar and along the west coast.

CHEMICAL COMPOSITION :—*Bassia Latifolia.*—The *seeds* contain 50 to 55 per cent. of a fatty oil. This oil is used by the Gonds and other Central Indian tribes for edible purposes and is not unfrequently used as an adulterant of 'ghee'. It is also largely used as a lamp oil and is said to be well adapted for soap manufacture.' The composition of the fats present in the seeds of *Bassia latifolia* has been worked out by R. G. Pelly (1912) at the Imperial Institute. The unsaturated acids yield on oxidation dihydroxy stearic acid with a M.P. of 130°C. No linolic acid could be found. The saturated acids have M.P. of 53°C, neutralisation value 205 and iodine value 12.7 per cent. On re-crystallisation from alcohol they yield nearly half their weight of stearic acid, some palmitic acid is also obtained. A saponin of the formula $C_{17}H_{26}O_{10}$ has also been separated from the seeds. The *leaves* contain a glucosidic saponin different from that obtained from the seeds has been reported. Traces of an alkaloid have also been found. The *flowers* form an important article of food, and a spirit is distilled from them. The flowers contain a fairly good quality of sugar, enzymes and yeast. Church gives the following figures of analyses for air-dried flowers :— Cane-sugar 2.2 per cent.; invert sugar 52.6; other substances soluble in water 7.2; cellulose 2.4; albuminoids 2.2; ash 4.8; water lost at 100°C 15.0; undetermined 12.6.

Bassia longifolia :—*Seeds* contain 40 per cent. of fatty oil, called 'bassia oil', of which about one-third is olein and two-thirds palmitin. More recent investigations show that about 55 to 57.8 per cent. of fat is contained in the seeds. About 60 per cent. of this fat is composed of olein and linolein and 40 per cent. is stearin and palmitin. After the oil is extracted, a sapo-glucoside called 'mowrin' is obtained from the residue. This has been isolated as a pale yellow powder soluble in all proportions in water and in methyl and ethyl alcohols. It is fairly toxic and has a specific action on the heart and circulation, similar in many respects to that of the drugs of the digitalis group (Moore and others). The *fruit* contains saccharose 4.6 to 16.2 per

cent. and maltose about 2.39 per cent. Besides these, they also contain a lot of tannin and enzymes.

Therapeutic Uses:—Both *Bassia latifolia* and *Bassia longifolia* are used for practically the same purposes. Because of their tannin content, they act as astringents. They are largely employed as a lotion in chronic ulcers, as a gargle in bleeding and spongy gums, and in acute and chronic tonsillitis and pharyngitis. A drachm of the liquid extract in 10 ounces of water makes a useful gargle. The leaves have also astringent properties. The ashes of the burnt leaves mixed with 'ghee' are often used as a dressing for burns and scalds in the indigenous medicine.

Internally, the bark is employed in diabetes mellitus with much benefit. The flowers are expectorant and nutritive, and are useful in chronic bronchitis, and wasting diseases. The oil is often used as an application in chronic rheumatism. It acts as a laxative and may be used in habitual constipation and hæmorrhoids.

Economic Aspects:—The economic importance of the flowers and fruits cannot be overestimated. The flowers of *B. latifolia*, are used for the manufacture of alcohol on a large scale. These flowers are considered to be good and cheap raw materials for the manufacture of power alcohol and are now being very largely employed in Bihar and Orissa, the Bombay Presidency and in Bengal.

References:—

(1) Fowler and others, 1920, *Jour. Ind. Inst. Sci.*, Vol. 3, p. 81; (2) Fowler and Dinanath, 1923, *Jour. Ind. Inst. Sci.*, Vol. 7, p. 273. (3) Roberts, 1931, *Vegetable Materia Medica of India and Ceylon*; (4) Moore, Sowton, Baker-Young and Wester, 1911, *Biochemical Journal*, Vol. 5, p. 94; (5) Pelly, 1912, *Jour. Soc. Chem. Industry*, Vol. 31, p. 98.

BERBERINE-CONTAINING PLANTS

The alkaloid *berberine* is well-known in medicine and is widely distributed in the vegetable kingdom. Berberine occurs chiefly in *Berberis aristata* and other members of the Berberis family (N.O. Berberideæ). It has been found to occur in the

rhizomes and roots of *Hydrastis canadensis* (N.O. Ranunculaceæ) to the extent of nearly 2.5 per cent. It is also present in a large number of plants belonging to the natural orders, Menispermaceæ, Papaveraceæ, and Rutaceæ. In both the Hindu and the Mohammedan medicine, the berberine-bearing plants have been used as diaphoretics and stomachics and in the treatment of many skin diseases. Although berberine-containing plants are largely used in the indigenous medicine in this country, the pharmacological action of berberine has not been fully worked out. Interest has also been recently aroused in this drug on account of its successful use in the treatment of cutaneous leishmaniasis (oriental sore).

The alkaloid berberine occurs in a large number of plants of the barberry family, growing in the northern and western parts of the Himalayas at an altitude from 1000 to 4000 feet above the sea level. They also grow in Bhutan and in the Nilgiris in the south of India ; in the European and American forests they are also to be found.

1. BERBERIS ARISTATA (N.O. Berberideæ)

The Barberry

VERN.—Hind.—*Chitra, Dar-hald, Kashmal* ; Punj.—*Sumlu, Chitra* ; Nepal.—*Chitra* ; Pers.—*Zarishk*.

The berries are known as 'zarishk' in Hindi and Persian. The extract made from it is known as 'rasaut' in Hindi and is a common household remedy in this country. *B. aristata, B. asiatica, B. lycium* and *B. vulgaris* are distinguishable with great difficulty and consequently they have been mistaken for each other in every part of India. Twelve species have been mentioned and hence the vernacular names are probably inaccurate. *B. aristata* grows in the temperate Himalayas at an altitude of 6000 to 8000 feet. It has been used in form of an extract under the name of 'rasanjana' or 'rasavanti' and also in form of a decoction. Mohideen Sheriff described it as one of the really few good drugs of the indigenous medicine and brought it to the notice of the medical profession. The root

bark is rich in alkaloidal content and was made official in the Pharmacopœia of India. A tincture made from it was used as a bitter tonic, stomachic, cholagogue, antiperiodic and alterative. In malarial fever it was reputed to be efficacious as a diaphoretic and antipyretic like Warburg's tincture. The yellow dye obtained from the root and the stem is of great commercial value ; it is reported to be the best yellow dye available in India and its supply is inexhaustible.

2. BERBERIS ASIATICA (N.O. Berberideæ)

VERN.—Hind.—*Kilmora* ; Nepal—*Matc-kissi, Chitra.*

It grows in the dry valleys of the Himalayas at an altitude of 3000 to 7500 feet. It grows in Bhutan, Garhwal, Behar and on the Parasnath Hill. The medicinal uses of this species are similar to those of *B. asiatica* and it contains berberine in fair quantities.

3. BERBERIS CORIACEA (N.O. Berberideæ)

VERN.—Simla—*Kashmal*

It is known in the vernacular as *Kashmal* and is a large, erect, thorny shrub growing in the North-West Himalayas at an altitude of 8,000 feet.

4. BERBERIS LYCIUM (N.O. Berberideæ)

VERN.—Hind.—*Kashmal, Chitra* ; U.P.—*Kushmul* ; Bomb.—*Darhalad* ; Pers.—*Zirishk* (the fruit).

It grows in dry hot places in the Western Himalayas at an altitude of 3,000 to 9,000 feet from Garhwal to Hazara. Royle in a paper read before the Linnæan Society of London described 'rasaut' as the same plant described by Pliny, and later by the Greeks. The medicinal extract from the root known under the name of 'rasaut' is a very highly esteemed drug in the indigenous medicine. O'Shaughnessy described it

as being useful as a febrifuge, carminative and gentle aperient ; in hæmorrhoids it is used both locally and internally.

There is some difference of opinion as to whether 'rasaut' should be regarded as a special preparation from the root of *B. lycium* only, or from *B. asiatica* or the two together. Most of the preparations offered for sale are derived from a mixture of the two plants ; 'rasaut' is a well-known remedy of the indigenous medicine and is prescribed in doses of from 10 to 30 grains with butter in bleeding piles, as a bitter tonic, and as a febrifuge. Mixed with butter and alum 'rasaut' is used as an external application for the eyelids in acute conjunctivitis. With camphor and butter it forms the constituent of an ointment used against acne, pimples and indolent ulcers. It has been found useful in enlargement of the liver and the spleen. Some physicians consider it to be useful in the treatment of gastric and duodenal ulcers.

5. BERBERIS NEPALENSIS (N.O. Berberideæ)

VERN.—Punj.—*Amudanda, Chiror* ; Nepal.—*Chatri, Milkisse.*

It grows commonly on the Outer Himalayas, from the Ravi eastward to Khasia and the Naga Hills and also in the Nilgiris at an altitude of 5,000 feet. It was used to a small extent by the Bhutias and Nagas as a yellow dye.

6. BERBERIS VULGARIS (N.O. Berberideæ)

The True Barberry

VERN.—Punj.—*Zirishk, Kashmal, Chachar* ; Pers.—*Bedana* ; Arab.—*Ambar-baris.*

It is a deciduous thorny shrub growing in the Himalayas from Nepal westwards, in the shady forests at an altitude of over 8,000 feet above the sea level. It is used largely in the Punjab as a diuretic for the relief of heat, thirst and nausea. It is considered to be astringent, refrigerant, and antibilious. In small doses it is said to be a tonic, in large doses it acts as a purgative. It was formerly used in jaundice.

Besides the various species of berberis just described, a number of other plants used in the indigenous medicine contain berberine. A few of these plants are mentioned below :—

1. **Argemone mexicana** (N.O. Papaveraceæ)

This plant contains large quantities of a yellow juice resembling that from gamboge containing small quantities of berberine. (See page 286).

2. **Coptis teeta** (N.O. Ranunculaceæ)

Gold Thread

VERN.—Hind.—*Mamira or Mamiran;* Assam—*Tita;* Sind.—*Mahmira.*

This plant is a native of the mountainous regions bordering on Upper Assam and has a reputation as an eye salve. The root, which is dark yellowish in colour and has a bitter taste, was made official in the Pharmacopœia of India. It is sent down to Assam in small baskets with open meshes of narrow strips of bamboo or rattan, each basket containing an ounce of small pieces of the dark yellowish bitter rhizome, 1 to 3 inches in length. It is not easily available in the plains. The chief active principle found in the bark is berberine which occurs in the root to the extent of 8.5 per cent. The drug is used in the indigenous medicine as a bitter tonic and resembles calumba in its properties. The fluid extract is the most suitable preparation. The roots of Picrorhiza and that of *Thalictrum foliolosum* are sold in the bazar as a substitute for the *Coptis teeta* root and are difficult to distinguish from it.

3. **Toddalia aculeata** (N.O. Rutaceæ)

VERN.—Hind.—*Jangli-kali-mirch;* Beng.—*Kada-todali.*

(See page 407).

4. **Coscinium fenestratum** (N.O. Menispermaceæ)

VERN.—Sans.—*Darvi, Daru-haridrakam;* Hind.—*Jhar-haldi;*
Beng.—*Haldi-gach;* Tam.—*Mara manjal.*

It is a climbing plant which grows plentifully in the forests of Western India. The wood yields a dye resembling turmeric. The root is regarded as a bitter tonic and stomachic and is used in the same way as calumba. It is said to contain berberine in small quantities.

Chemistry of Berberine:—Berberine $C_{20}H_{19}NO_5$ is one of the chief constituents of *Berberis aristata* and *Hydrastis canadensis* (Golden seal). In the latter it occurs to the extent of nearly 2.5 per cent. along with two other alkaloids known as *hydrastine* and *canadine*.

Berberine is an intensely yellow and bitter alkaloid. It is widely distributed in the root and bark and is the main source of the yellow colour of these plants. Berberine crystallises from water in long silky, reddish-yellow needles with $5\frac{1}{2}H_2O$; from chloroform it forms triclinic tablets containing $1\,CHCl_3$; the acetone compound, $B.C_3H_6O$, forms reddish-yellow tablets. Berberine melts at 144°C and when acidulated with sulphuric acid in a test tube and brought in contact with chlorine water it gives a blood-red ring at the junction. It precipitates with nearly all the alkaloid precipitants.

Berberine base dissolves in 4.5 parts of water at 21°C. A number of salts, such as the carbonate, sulphate, hydrochloride, etc., have been prepared. They all have a yellow colour and are very sparingly soluble in water, except the acetate and the phosphate which have a solubility of 1 in 15 parts of water. The solubility of the sulphate is 1 in 150, but the acid sulphate is more soluble; the hydrochloride is soluble 1 in 400 parts of water. The solubility in water increases on warming the solution or on the addition of alcohol and benzol.

Pharmacological Action of Berberine:—Berberine is not a very toxic alkaloid, its minimum lethal dose for rabbits being about 0.1 gm. per kilogram of body weight when administered subcutaneously. When administered intravenously to cats and dogs under urethane anæsthesia its toxicity is about 0.025 gm. per kilogram of body weight. Post-mortem examination of animals which are given lethal doses of the drug shows a marked congestion of the lungs and a wide dilatation of the auricles. Berberine is absorbed fairly rapidly when given by subcutaneous and intramuscular injections and does not set up any marked local reaction even when a 10 per cent. solution is injected. When the alkaloid is given by the mouth it can be detected in the urine within a few hours showing that it is absorbed from the gastro-intestinal tract, and is excreted through the kidneys. A portion of it is, however, oxidised in the body.

Berberine has a stimulant action on the movements of the gastro-intestinal tract. The contractions of the stomach in an unanæsthetised cat are increased by subcutaneous injections of berberine. Intravenous injections of small doses of the alkaloid in anæsthetised animals, *e.g.*, the cat and the dog, show a

stimulant action on the movements of the small intestines. Perfusion experiments with pieces of different portions of the gut also show an increase in the tone of the muscle with such concentrations as 1 in 50,000 and less.

The cardio-vascular system is depressed by intravenous administration of berberine salts. There is a sharp fall of blood pressure, the degree of fall and its duration depending upon the dose administered. This is due to dilatation of the blood vessels of the splanchnic area in particular. The force and amplitude of the isolated mammalian heart is decreased by such dilutions as 1 in 50,000. In myocardiographic experiments both the auricles and the ventricles are depressed and the heart shows a distinct dilatation.

The respiratory system is markedly affected by the drug. Intravenous injections show an initial stimulation which might be due to the lowering of blood pressure or due to emboli formed in the capillaries of the lungs. The initial stimulation, however, soon gives way to depression especially when larger doses are given. The respiratory centre is depressed and death is generally due to failure of the respiration ; the heart goes on beating long after the respiration stops.

Gupta and Dikshit (1929) have shown that berberine is toxic to *Leishmania tropica* in concentrations as high as 1 in 80,000, while powerful protoplasmic poisons like quinine or emetine require about 80 times this concentration to produce the same effect. This specific toxic action of berberine has led to its use in 'oriental sore', due to an infection by *Leishmania tropica.*

Therapeutic Uses :—Berberine-containing plants have been used by both the Hindu and Mohammedan physicians as a stomachic, bitter and tonic in the same way as quassia and calumba. They have been used as an antiperiodic and alterative in remittent types of fevers. They have also been used in the treatment of leprosy, snake-bite, jaundice and vomiting of pregnancy. The fruits or berries of *B. asiatica* are given as a mild laxative to children. The stems are said to be diaphoretic and laxative and are recommended in rheumatism. The root bark is rich in bitter principles and is used as a tonic

and antiperiodic. Instead of the root bark, the root itself is employed as an antiperiodic, diaphoretic and antipyretic and its action was believed to be as powerful as quinine. A decoction made from the root was said to bring down fever. The dried extract of the root known as 'rasaut' or 'ras' is used as a purgative for children, as a blood-purifier and as an external application in conjunctivitis in combination with opium. As a local application it is used for indolent ulcers. It has also been recommended for gastric and duodenal ulcers.

Malaria :—Berberine and its compounds are reputed to have effective antiperiodic properties and have been used by Indian physicians in the treatment of malaria for a long time. The author has used berberine sulphate in patients suffering from malaria at the Carmichael Hospital for Tropical Diseases, Calcutta. The drug was administered in 3 to 5 grain doses three times a day for three consecutive days, but there was no change in the paroxysms and microscopical examination showed no change in the number of malarial parasites.

In a series of 9 cases which were tested, in no instance was there any change in the signs and symptoms of the patients. All infections whether those with *P. malariæ*, *P. vivax* or *P. falciparum* remained unaffected by the alkaloid. Quinine administration in these patients had the desired therapeutic effect. It will be seen, therefore, that the belief that berberine is useful in malaria is not founded on facts.

There is still another use of berberine in malaria not as a curative agent, but as a diagnostic measure. It is said to liberate the parasites into the circulation so that, whereas blood films taken before the administration of berberine are negative, those taken after it are positive. Sabastine (1926) used berberine as a provocative agent for the diagnosis of latent malaria. Percy Andre (1927) advocated the hydrochloride in cases of malarial splenomegaly. Chopra (1927) showed that injections of pentavalent compounds of antimony produce an increase in the volume of the spleen and the liver. Besides this, the rhythmic contractions of these organs are stimulated. The spleen is known to act as a filter to remove micro-organisms such as bacteria and protozoa from the blood stream and malarial parasites occur in

large quantities in this organ. Berberine has been shown to increase the volume of the spleen and to increase its rhythmic contractions. It will, therefore, expel malarial parasites into circulation in the same way as Chopra and Das Gupta (1928) have shown that injections of antimony compounds expel the leishmania.

Oriental Sore :—The most important use of berberine is, however, in the treatment of oriental sore. Jolly in 1911 first tried 'rasaut', which contains large quantities of the crude alkaloid, in the treatment of this condition with varying results. Varma (1927) was the first to use berberine sulphate successfully in the treatment of oriental sore. Karamchandani in the same year tried different methods of treating the sore and reported that injections of berberine sulphate were most successful. Das Gupta and Dikshit (1929) tried berberine in patients suffering from sores as well as in experimentally-produced lesions in mice and concluded that the drug had a specific effect in curing these conditions. Lakshmidevi in the same year reported several cases of oriental sore successfully treated with local injections of berberine. There is, therefore, no doubt about the effectiveness of this alkaloid in this form of cutaneous leishmaniasis. The following technique has been recommended :—

1 to 2 c.c. of a 1 per cent. solution of the sulphate is infiltrated into the margins of the sore by means of a fine hypodermic syringe. Four or more punctures are made and care is taken to see that the infiltration is evenly spread. Injections are given once a week, and the sore is dressed with ordinary surgical dressings. As a rule not more than three injections are required to bring about a complete cure, but a large number of injections may have to be given until the desired results are obtained. It must be remembered, however, that if there are multiple sores on the body, it is not advisable to infiltrate more than two sores a day and not more than four sores a week, especially if the sores are of a large size.

The solutions of berberine sulphate are stable and can be preserved in sterile tubes with rubber caps, so that the requisite amount can be withdrawn with a syringe whenever required for

administration. Messrs. May and Baker have recently put on the market ready-made solutions of berberine under the trade name 'orisol'.

References :—

(1) Jolly, G. G., 1911, *Ind. Med. Gaz.*, Vol. 46, p. 466; (2) Varma, R. L., 1927, *Ind. Med. Gaz.*, Vol. 62, p. 84; (3) Karamchandani, 1927, *Ind. Med. Gaz.*, Vol. 62, p. 558; (4) Chopra, R. N., 1929, *Ind. Jour. Med. Res.*, Vol. XVI, Jan.; (5) Chopra, R. N., and Das Gupta, C. R., 1928, *Ind. Jour. Med. Res.*, Vol. XV, Jan.; (6) Das Gupta and Dikshit, 1929, *Ind. Med. Gaz.*, Vol. 64, p. 67; (7) Lakshmidevi, A., 1929, *Ind. Med. Gaz.*, Vol. 64, p. 139; (8) Chopra, Dikshit and Chowhan, 1932, *Ind. Jour. Med. Res.*, Vol. XX; (9) Chopra, Dikshit and Chowhan, 1932, *Ind. Med. Gaz.*, Vol. 67.

BŒRHAAVIA DIFFUSA (N.O. Nyctagineæ)

VERN.—Sans.—*Shothaghni* (cure for dropsy) ; Hind.—*Sánt* ; Punj.—*Itsit* ; Beng.—*Punarnaba* ; Bomb.—*Ghetuli* ; Tam.—*Mukukrattai.*

Bœrhaavia diffusa or *punarnava* has been in use in the indigenous medicine from time immemorial. The Ayurvedic authorities recognise two varieties of this plant, the one with white flowers called 'shweth-purna', and the other with red flowers, the 'rakt-purna'. In the Tibbi literature a third variety with blue flowers has also been described.

The plant grows all over India as a common creeping troublesome weed and is specially abundant during the rains. The roots are stout and fusiform and have a bitter and nauseous taste. From the root numerous stems, 2 to 3 feet long, slender and covered with minute hairs, are given off. The stem is often viscid and glabrous; the leaves are thick, arranged unequally, green and glabrous above and usually white underneath. The base of the leaf is rounded and subcordate, and the petioles are as long as the leaves. The flowers are small and sessile 4 to 10 together in small bracteolate umbels forming slender, long-stalked axillary and terminal petals. The fruit is oblong, dull-green or brownish and about the size of a caraway bean.

Dhanvantari described the white variety in 'Nighantu' as possessing laxative and diaphoretic properties. Its efficiency in

œdema, anæmia, heart disease, cough and intestinal colic has also been mentioned by him. The red variety is bitter and its beneficial effects in œdema, hæmorrhage, anæmia and biliousness have been extolled.

In 'Rajnighantu', it is recommended in diseases of the nervous system, and in 'Bhavaprakash', in heart disease and piles. Charaka used it in the form of an ointment in leprosy and skin diseases, and as a decoction in stone in the kidney and in œdema. Local applications of the root paste have been recommended in œdematous swellings. Susruta mentions its use in snake-poisoning and rat-bite infection. Chakradatta used it in the treatment of chronic alcoholism and various other writers recommended it in phthisis, insomnia, rheumatism and diseases of the eye. The Tibbi physicians lay stress on its use in asthma, jaundice and ascites and mention its diuretic properties. They also use it as a vermifuge and febrifuge and in urethritis.

Chemical Composition :—Ghoshal (1910) analysed the drug and found the following constituents :—(*a*) A sulphate of a body alkaloidal in nature, (*b*) an oily amorphous mass of the nature of a fat, (*c*) sulphates and chlorides and traces of nitrates and chlorates from the ash. The amount of the alkaloidal matter is very small. The sulphate of the alkaloid is described as small needle-shaped crystals, brownish-white in appearance when in mass. Its taste is nearly bland or very faintly bitter and resembles that of impure quinine sulphate. The yield of the alkaloid as sulphate was 300 mgm. from 20 oz. of the original plant (*i.e.*, 0.053 per cent.).

A detailed study of the chemical composition and pharmacological action of the active principles was undertaken by the author and his co-workers. As the green plant contained a very high percentage of water the air-dried plants had to be used for extraction.

The plant was found to contain unusually large quantities of potassium nitrate. As the presence of this salt may partly account for the diuretic action of the drug, the total content of potassium present in the plant was estimated. Taking the whole of potassium as potassium nitrate, its quantity in the powdered drug amounted to about 6.41 per cent. This is, however, unlikely and it is probable that other salts of potassium are present. Besides these salts, there is an alkaloid present in very small quantities, about 0.01 per cent. of the weight of dry plant. The alkaloid was isolated in just sufficient quantity for pharmacological experiments. It had a bitter taste and the hydrochloride was obtained in crystalline form. It has been named 'punarnavine'. The quantity, however, was not sufficient for further chemical work.

Pharmacological Action :—Ghoshal (1910) first took up the investigation of this drug. He used an aqueous extract of the whole drug in his experiments. This for obvious reasons is liable to cause error as the large quantity of nitrates, besides other salts of potassium and various constituents, would mask the effect of the alkaloid and produce their specific effects on the tissues. His main conclusions were as follows :—(1) The active principle is a diuretic, chiefly acting on the glomeruli of the kidneys through the heart, increasing the beat and strength and raising the peripheral blood pressure in consequence; on the cells of the tubules it exerts little or no action, and if any, it is initial and comparative. (2) On the respiration it has little or no action; any action is probably due to the fatty principle found in the weed. (3) On the liver the action is principally secondary and in combination with other drugs. (4) On the other organs the drug has practically no effects.

In the experimental work done by the author and his co-workers, the hydrochloride of the alkaloid was used. It has little or no irritant action on the intact skin and mucous membrane. Subcutaneous injection does not set up any marked local reaction ; it has a somewhat depressing action on the tone and peristaltic movements of isolated pieces of the intestine from the rabbit. Intravenous injection of the alkaloid stimulates the respiratory movements in experimental annimals but there is no relaxation of bronchial muscles such as occurs with adrenaline. The blood pressure shows a distinct and persistent rise which is probably due to the direct action of the drug on the heart muscle. The diuretic effects were investigated in the cat and the dog ; intravenous injections in such animals, where the flow of urine is being recorded by a cannula into the ureter, showed a marked increase in the flow of urine. That the diuresis was not entirely due to the rise of blood pressure was shown by giving 1/20 c.c. of 1 in 1000 adrenaline solution intravenously ; it was observed that, although there was a much bigger rise of blood pressure, the diuresis was comparatively much less marked. It may be concluded, therefore, that the effect of the alkaloid is probably chiefly on the renal epithelium. That the alkaloid is not very toxic was shown by the fact that large doses given to animals produced no untoward effects.

Therapeutic Uses:—The fact that most of the previous observers laid great stress on the diuretic properties of *Bœrhaavia diffusa*, and that these results were confirmed by animal experiments, led the author to test the drug in patients suffering from œdema and dropsy due to various causes. As a sufficient quantity of the alkaloid could not be obtained for clinical trials we had to use the liquid extract prepared from the plant. The extracts were made both from the dry and fresh plant (white variety) and were found to be equally efficacious. One c.c. of the extract was equivalent to 1 gm. of the dried plant and this was given in doses ranging from 1 to 4 drachms. The amount of the alkaloid in such doses worked out to be 0.35 to 1.40 mgm. or roughly 1/40 to 1/160 grain. The total amount of potassium base (not salts) in similar doses would be 1.5 to 6.0 grains and of this potassium nitrate would be ½ to 2 grains. The drug was carefully tried in a series of 34 cases. This series, though not very large, gave convincing results about the therapeutic effects produced by the drug. Excepting an occasional purgative no other drugs were given whilst the extract was being administered. In cases of ascites due to early liver and peritoneal conditions the drug appears to be very beneficial. It produced a very marked and persistent diuresis and in some cases the ascites entirely disappeared. The diuretic effect, though not so marked, was produced even when the abdominal fluid was not removed by preliminary tapping and the kidneys were working under a disadvantage. If the tension inside the abdomen was high and the urine was scanty and albuminous the drug failed to produce an effect unless the ascites was previously relieved.

A number of the patients on whom the drug was tried were either complicated with kala-azar or the dropsical condition was possibly due to kala-azar. In them the improvement was not marked until the treatment with antimony injections was given simultaneously. It may be argued that the beneficial results in these cases were entirely due to the effect of antimony injections but it was found that such marked diuresis is as a rule not caused by antimony alone. In some of the cases cited below the amount of urine was two to three times the normal quantity

secreted in healthy individuals, and this increase was maintained even when the ascites and œdema had disappeared and after the antimony injections were stopped. As a matter of fact, ascites in cases of kala-azar is not a common condition and when it appears is usually terminal. The drug acts best when the dropsical condition is associated with healthy kidneys as in kala-azar or ascites caused by dysenteric conditions. Diuresis, though it does occur in patients with copious albumin in their urine, is often not so marked. As regards dropsy due to cardiac conditions, its effect does not appear to be very marked. In such cases digitalis or the ephedrine group of drugs are much more efficacious. In ascites with advanced structural changes in the liver, kidneys and peritoneum, only temporary benefit can be expected, but even in such cases the condition is greatly improved.

In a certain number of cases the quantity of urine decreased somewhat after prolonged administration of the drug for a period of 4 to 6 weeks and it was thought that perhaps this was due to the toxic effect of the drug. To test this point, 2 to 3 drachms of the extract were given three times a day for over 2 months to several cases. It was observed that the quantity of urine passed did not materially alter and in some cases the diuretic effects were maintained even after the drug was discontinued. In one case, the diuresis was maintained for nearly six weeks after the administration was stopped.

Summary :—The active principle of *Boerhaavia diffusa* is a body of alkaloid nature called 'punarnavine'. There are also large quantities of potassium nitrate and other potassium salts present in this plant. Intravenous injections of the alkaloid in experimental animals produce a distinct and persistent rise of blood pressure and a marked diuresis. The diuresis is mainly due to the action of the alkaloid on the renal epithelium, although the rise in blood pressure may contribute towards it. Clinically, 1 to 4 drachms of the liquid extract made from either the dry or the fresh plant, produce diuresis in cases of œdema and ascites, especially those due to early liver, peritoneal and kidney conditions. When the liquid extract is used the presence of a large amount of potassium salts no doubt reinforces the action

of the alkaloid. The drug appears to exert a much more powerful effect on certain types of ascites, *i.e.*, those due to early cirrhosis of the liver and chronic peritonitis (Hale White) than some of the other diuretics known.

References :—

(1) Ghoshal, L. M., 1910, *Food and Drugs*, October, p. 80; (2) Chopra, R. N., Ghosh, S., Ghosh, B. N. and De, P., 1923, *Ind. Med. Gaz.*, Vol. LVIII, p. 203.

BUTEA FRONDOSA (N.O. Leguminosæ)

Bengal Kino ; Butea Gum.

VERN.—Sans.—*Kinsuka, Palása* ; Hind.—*Palas, Tesu, Chichra* ; Beng.—*Palas* ; Pers.—*Palah*.

This is a moderate sized deciduous tree found throughout India and Burma extending in the North-West Himalayas as far as the Jhelum. It is one of the most beautiful trees of the plains and lower hills of India and nearly every part of this tree has been put to some useful purpose. It yields naturally or from artificial scars on the bark, a gum which is sold as 'Bengal kino'. The gum was mentioned by Chakradatta as an astringent and in combination with rock salt was used as an external application. It is largely used as an astringent and as a substitute for the 'kino' in India and to a limited extent in Europe also. Waring in his 'Bazar Medicines' remarks that it is an excellent astringent, similar to catechu, but mild in operation and hence is better adapted for children and delicate females. The dose of the powdered gum is 10 to 30 grains with a few grains of cinnamon. The flowers and leaves are also used. They are said to possess astringent, diuretic and aphrodisiac properties. Made into the form of a poultice, they are used as antiphlogistics in swellings and boils. The fresh juice is given internally in phthisis and also as an external application, to ulcers and congested and septic throats.

The seeds have been administered internally, either in the form of powder or made into a paste with honey, as an anthelmintic from very ancient times. In the 'Bhavaprakasa', the use

per cent. of an oil, 1.925 per cent. of a bitter principle, 6.83 per cent. of sugar and 3.791 per cent. of salts. A non-alkaloidal bitter principle was obtained from the kernels in the form of a white powder (bonducin) to which they attributed the physiological properties of the seeds. It was found to be insoluble in water but soluble in oils. Bacon (1906) was able to isolate from the kernels the bitter principle 'bonducin' which he found to be a mixture of complex resinous bodies. He could not obtain any alkaloid or glucoside from the alcoholic extract of the kernels. Bhaduri (1912) stated that an alkaloid was present in the seeds and suggested the name 'natin' for it. It is doubtful whether 'natin' of Bhaduri is a glucoside or an alkaloid as details are not available. Godbole, Paranjpe and Shrikhande (1929) found that the bitter principle of the kernels extracted with alcohol, contained all the sulphur of bonducella nut and reduced Fehling's solution after hydrolysis. They concluded, therefore, that the bitter principle was a glucoside. Tummin Katti (1930) found a bitter resinous acid in the petroleum ether extract and identified it as 'bonducin'.

In view of the divergent results of chemical analysis, the seeds were re-examined at the Calcutta School of Tropical Medicine to see what active principles could be detected in them. They yielded to petroleum ether 13.52 per cent., sulphuric ether 1.84 per cent., chloroform 0.42 per cent. and absolute alcohol 18.55 per cent. of the dried extract. Each of the above fractions was then chemically examined. The presence of an alkaloid as noted by the previous investigator could not be confirmed, but a non-glucosidic bitter principle insoluble in water was undoubtedly present; it is, however, pharmacologically inactive. The seeds contain a fairly good percentage of pale yellow thick oil having a disagreeable odour. It has an iodine value of 96.1 and saponification value of 292.8. According to some workers the quantity of the oil varies between 20 to 25 per cent., whereas in the specimens examined by the author it never exceeded 14 per cent.

Pharmacological Action :—The non-glucosidic bitter principle was passed through the usual pharmacological tests but it was found to be inactive.

Therapeutic Uses :—The so-called 'bonduc nuts' or 'fever nuts' have enjoyed a reputation as anti-periodic for such a long time that clinical trials were carried out under the auspices of the Indigenous Drugs Committee. Though their findings are not very definite, they recommended the drug very favourably as a powerful tonic and a valuable febrifuge. As the seeds do not show any marked therapeutic properties and the re-investigation of their chemical composition does not reveal the presence

of any active principle with marked pharmacological action, further clinical trials were considered unnecessary.

References :—

(1) Chopra, R. N. and Ghosh, S., 1929, *Ind. Jour. Med. Res.*, Vol. XVII, p. 377; (2) Bacon, 1906, *Philippine, Journal, Sci.*, Vol. I, Part II, p. 1032; (3) Bhaduri, 1912, *Proc. Chem. Soc.*, Vol. 28, p. 53; (4) Godbole, Paranjpe and Shrikhande, 1929, *Jour. Ind. Chem. Soc.*, Vol. VI, p. 295; (5) Tummin Katti, 1930, *Jour. Ind. Chem. Soc.*, Vol. VII, pp. 207 & 221.

CALOTROPIS GIGANTEA (N.O. Asclepiadeæ)

Gigantic Swallow-wort

VERN.—Sans.—*Mandára, Árka, Álarka, Surya pattra* ; Hind.—*Ak, Madar* ; Beng.—*Akanda* ; Tam.—*Erukku* ; Tel.—*Mandaramu.*

The medicinal properties of *Calotropis gigantea* were known in this country from the earliest time. It is mentioned by the earliest Hindu writers and the ancient name of the plant which occurs in the Vedic literature was Arka (wedge) alluding to the form of leaves which was used in the sacrificial rites. The vernacular name 'madár' is derived from 'mandára', one of the sanskrit names of the plant. Two varieties of the plant are described by the sanskrit writers, *viz.*—the white flowered or 'alarka' (probably *C. procera*) and the purple flowered or 'arka' (*C. gigantea*). The ancient Arabs also held superstitious notions about calotropis, probably connected with sun worship.

C. gigantea is an erect perennial shrub, growing chiefly in waste lands. It ascends to an altitude of 3,000 ft. on the Himalayas, and extends from the Punjab to South India, Assam, Ceylon and Singapur and is distributed to the Malaya Islands and South China. It thrives in soil where nothing else will grow and requires neither cultivation nor water; it is thus admirably adapted for bringing waste lands under tillage and for protecting reclaimed deserts from drifting sands. These reasons alone should suffice to encourage the cultivation of the plants apart from its value as a medicinal plant or fibre producer. The root barks of *C. gigantea* and *C. procera* are similar in appearance and occur in short pieces 1/8 to 1/5 inch thick. The taste is mucilaginous and bitter and the odour is peculiar.

A kind of gutta-percha may be prepared from the milky sap. But calotropis gutta-percha cannot be regarded of any commercial importance

also evidence is wanting in support. The milky juice is applied locally to the os uteri for inducing abortion. The most important medicinal property of the fruit is found in 'papain', a digestive enzyme, which is present in the milky juice and also occurs to a certain extent in the green fruit.

In the early stages, the fruit secretes a white milky viscid juice of the consistency of cream which has the extraordinary property of hastening the decay of muscular fibre exposed to its influence. This active principle, which resembles pepsin in its physiological properties, may be obtained by adding alcohol to the juice of the unripe fruit and powdering the residue after drying. This substance is called 'papain' and is superior to ordinary animal pepsin in having the peculiar additional advantage of requiring neither the aid of an acid nor an alkali to convert the contents of the stomach into peptones. The digestive action of this plant on meat was probably known in the West at a very early date and appears to have been communicated to India upon the introduction of the tree by the Portuguese. The author of the 'Makhzan-el-adwiya' (1770) accurately describes the tree and mentions the use of the juice mixed with fresh ginger, for making meat tender. Although this property of the fruit and leaves seems to have been known throughout India for a long time, no attempt appears to have been made to manufacture 'papain' (vegetable pepsin) on a large scale. Of recent years, a small trade has sprung up in some countries in the preparation of 'papain' from this fruit.

Chemical Composition :—The milky juice of papaw contains a ferment which has an extraordinary energetic action upon nitrogenous substances and like pepsin curdles milk. This juice differs from pepsin in being active without the addition of free acid; moreover the ferment acts at a higher temperature than animal pepsin.

The leaves of the papaw tree have been shown to contain an alkaloid called *carpaine* and a glucoside named *carposide*. This alkaloid was first discovered by Greshoff and has been further examined by Merck and by van Rijn who found that it is a secondary base. The present accepted formula is $C_{14}H_{25}O_2N$. The alkaloid can be purified by repeatedly crystallising the base from dilute spirit when it occurs in the form of colourless, lustrous, needle-shaped crystals with a melting point of 121°C.

Pharmacological Action of Carpaine:—The pharmacological action of the alkaloid carpaine is under investigation. From the data already in hand, it is evident that it is not very toxic. A dose of 5 mgm., when injected intravenously in experimental animals, causes only a slight fall of blood pressure which, however, returns to the normal level within a very short time. The action of the heart is depressed and both the ventricles and auricles show evidence of slight depression. The respiration is not depressed to any great extent. The volumes of the different organs are very slightly affected, if at all.

The alkaloid has not been used in therapeutics.

CEPHALANDRA INDICA (N.O. Cucurbitaceæ)

VERN.—Sans.—*Bimba* ; Hind.—*Kanduri-ki-bel* ; Beng.—*Telákuchá* ; Bomb.—*Bhimb* ; Tam.—*Kovai* ; Punj.—*Kandúri* ; Pers.—*Kabare-hindi.*

Cephalandra indica is a perennial creeping herb with long tapering tuberous roots and deep green leaves. It grows in a wild state abundantly in Bengal and in most parts of India. It has a smooth green fleshy fruit with an extremely bitter taste. When ripe the fruit becomes scarlet in colour and sweet to the taste and is sometimes eaten as a vegetable. The plant has the reputation in Bengal of having a remarkable effect in reducing the amount of sugar in the urine of patients suffering from diabetes mellitus. It has been described by some as the 'Indian substitute for insulin', and among the medical practitioners in Calcutta a strong belief exists as to its efficacy in glycosuria. The green juice extracted from the plant was tried in some of the surgical cases suffering from glycosuria in the Calcutta Medical College Hospitals with apparently beneficial results. The quantity of sugar was said to be greatly reduced and in some cases entirely disappeared. Previous to this, the drug is said to have been tried many years ago and some experimental work was also done in the Department of Physiology at the Medical College, but no record of this work could be discovered in the published literature. The origin of

the belief that the drug has anti-diabetic properties can be traced to its use by the Ayurvedic physicians who give the fresh juice extracted from the tuberous roots and leaves, either by itself or in combination with certain metallic preparations, in the treatment of diabetes.

Chemical Composition :—The fresh plant was chemically analysed by the author and his co-workers. Not only was a search made for the ordinary active principles which are found in plants (*e.g.*, glucosides and alkaloids) but bodies of the nature of hormones and enzymes which are sometimes present were also investigated. Dubbins and Corbett (1923) have shown that in certain plants and vegetables both the blood-sugar-reducing and blood-sugar-increasing principles are present. When the former are freed from the latter and are injected into normal rabbits they produce a fall of blood sugar typical of that caused by an injection of insulin. Collip (1923) isolated a substance called *glucokenin* which has the property of reducing the amount of sugar in the blood. The object in separating bodies of this nature from the *Cephalandra indica* was to see whether any such sugar-reducing principles were present.

The method employed for separation of these bodies was principally the same as that used by Collip for isolating glucokenin. The fresh plant was crushed and the juice was expressed. To this twice its volume of alcohol was added, which precipitates the enzyme and chlorophyll. The enzyme was isolated by washing the precipitate with alcohol and drying in a vacuum. It was then treated with a small quantity of water which dissolved the enzyme. After filtering this, the enzyme was precipitated with twice its volume of alcohol and dried *in vacuo*. For the separation of the hormone, the solution after precipitation of the enzyme and chlorophyll was concentrated *in vacuo* at 60°C to a small bulk and filtered. It was then saturated with ammonium sulphate which precipitated the hormone; the precipitate was extracted with 70 per cent. alcohol. This was then filtered and the clear liquid was added to 40 volumes of 95 per cent. alcohol, neutralised and kept overnight. The precipitate which settled at the bottom was removed and dried.

The solution after separation of the hormone was acidified with dilute sulphuric acid and shaken with ether to remove any oily substance and then made slightly alkaline with ammonia. The ammoniacal solution was shaken with chloroform, which took up the alkaloid, which was thus obtained by evaporation of the solvent. By use of this technique *Cephalandra indica* was found to contain an enzyme, a hormone and traces of an alkaloid.

Pharmacological Action :—The activity of the enzyme isolated was tested. It had well-marked amylolytic properties and rapidly hydrolysed

starch. On the proteins it had no effect. The effects of subcutaneous injection of the hormone on the blood sugar were also tested in rabbits. The blood was examined for seven days after the injection of the hormone but besides the normal variations which usually occur, no marked effect was produced. The alkaloidal body was also tested but did not show any pharmacological action on the heart, respiration, blood pressure, and isolated uterus. Neither the alkaloid nor the enzyme had any sugar-reducing properties when administered to rabbits.

Clinical Trials:—The effect of the drug was tested on a series of diabetic patients who were selected at random as they came to the hospital for admission. The carbohydrate intake was fixed and kept strictly under control. The total quantity of urine in 24 hours was carefully collected and part of it was examined every day for the quantity of sugar. The blood sugar was also examined from time to time, the minimum fasting level after a total fast for 5 to 6 hours being determined in each case. The patients were regularly weighed during the entire period of the trial. After the patient was put on a strict diet of known carbohydrate value, some time was allowed for the daily output of sugar to run to a constant level. The patients were then put on a freshly-extracted juice of the stem and leaves of the plant, the dose being one to two ounces, every morning on an empty stomach. There was no reduction in the percentage of sugar excreted, total sugar or blood sugar. Insulin was given to these patients after cephalandra was stopped and in three days the sugar entirely disappeared from the urine.

The apparent beneficial results obtained after administration of this plant are probably due to the fact that a large number of cases of so-called diabetes in this country are really cases of intermittent glycosuria and these patients often improve without any medical interference. The sugar may disappear entirely with variations in diet, exercise, etc. There was at least one example of it in this series in which there was apparent reduction of sugar in urine from 105 gm. to 54 gm. after five doses of the fresh juice of the drug. The drug was then stopped but the improvement in the patient continued and the sugar excretion was reduced to 5 gm. a day and the blood sugar to 0.182 per cent. after eleven days. On further investigation it was found that this was a very early case of diabetes having a very good tolerance for sugar. In another patient on the other hand, who was excreting only 14 gm. of sugar a day, even after eight days' treatment with the drug the daily

sugar excretion, blood sugar and the weight of the patient remained practically unchanged. In yet another patient, the sugar value of the diet was 48 gm. and the sugar excretion per day was 45 gm. Fresh juice of the plant was tried for thirteen days with no effect but as soon as the diet was reduced by 10 gm. only the sugar disappeared. This shows clearly that *Cephalandra indica* could not even effect the utilization of 10 gm. of carbohydrates.

Therapeutic Uses:—It is obvious from the above that administration of the fresh juice of this plant does not produce any reduction of the sugar either in the blood or in the urine in cases of diabetes and that any reduction that is met with is purely dietetic.

Summary:—*Cephalandra indica* contains an enzyme with amylolytic properties, a hormone and traces of an alkaloid. None of these substances reduces sugar when administered subcutaneously to rabbits. Fresh juice extracted from the leaves, stem and root of the plant produces no reduction of sugar in the blood or urine of patients suffering from glycosuria.

References:—

(1) Chopra, R. N., and Bose, J. P., 1925, *Ind. Jour. Med. Res.*, Vol. XIII, July.

CROCUS SATIVUS (N.O. Irideæ)

Saffron

VERN.—Sans.—*Kumkuma, Saurab, Kasmirajanma*; Hind.—*Kesar, Jafran*; Beng.—*Jafran*; Bomb.—*Safran, Kessar*; Mar.—*Kecara*; Guj.—*Keshar*; Tam.—*Kungumapu*.

Saffron is an onion-like plant about 1½ feet high commonly found in Kashmir and around Quetta. The saffron of commerce consists of the dried stigma and tops of styles of the flowers of *Crocus sativus*. The plant does not appear to be indigenous to India but has been cultivated in Kashmir and recently also in Quetta. It may be propagated from seeds and offsets of bulbs. The yield per acre has been estimated to be 10 to 11 lbs. of dry saffron which is equivalent to 50 to 55 lbs. of fresh material. A great deal of care and attention has to be

taken in the cultivation and preparation of saffron for the market. The flowers are picked very early in the morning when half open. The stigmata are then separated and at once transferred to sieves, placed on earthen kilns or pots containing a slow fire. Gentle heat has to be applied otherwise the material gets soft and deteriorated.

Saffron is very largely used in the indigenous medicine in India. It is more popular in the Tibbi or Mohammedan medicine than in the Ayurvedic or Hindu medicine. As a stomachic and antispasmodic, it enjoys a great reputation. As a stimulant and an aphrodisiac, it is considered to be a sovereign remedy, not to be excelled in virtue by the whole range of drugs in the materia medica. In European medicine, saffron is used to a very limited extent, if at all. It is used mainly in cookery and as a colouring and flavouring material.

Chemical Composition:—Saffron has been chemically analysed and is found to contain the following substances:—

(*a*) Three crystalline colouring matters (1) α-crocetin ($C_{24}H_{28}O_5$ M.P. 272°—273°) constitutes 0.7 per cent. of saffron. (2) β-crocetin ($C_{25}H_{30}O_5$ M.P. 205°—206°) constitutes 0.7 per cent. of saffron and (3) γ-crocetin ($C_{26}H_{32}O_5$, M.P. 202°—203°) constitutes 0.3 per cent.

(*b*) A bitter substance.

(*c*) A fatty oil 8 to 13.4 per cent.

(*d*) An essential oil 1.37 per cent.

Pharmacological Action:—The essential oil from *Crocus sativus* was passed through the pharmacological tests. It showed all the characteristic features of an essential oil. We could not find any special point on which its action differed from other members of the essential oil group mentioned in the Pharmacopœias. Its aphrodisiac virtue is probably due to the slight stimulation of the central nervous system which is common to all the essential oils.

Therapeutic Uses:—Clinical trials have not been carried out recently by any worker to confirm the claims made regarding the efficacy of the drug.

Reference:—

(1) Dutt, 1928, *Commercial Drugs of India*; (2) Wehmer, 1929, *Die Pflanzenstoffe*, p. 171.

EUPHORBIA PILULIFERA (N.O. Euphorbiaceæ)

VERN.—Hind.—*Dudhi* ; Beng.—*Bura keru* ; Tam.—*Amum-patchay-arissi* ; Tel.—*Nanabeeam* ; Guj.—*Dudeli.*

Euphorbia pilulifera is an annual herb which occurs throughout the hotter parts of India. In the indigenous system of medicine, it has a great reputation and is believed to be a sovereign remedy for diseases of the respiratory tract in general, especially cough, coryza, bronchitis, asthma, etc. Many years ago it attracted the attention of the Western physicians who came to India and it was through their influence that the drug was introduced into Europe somewhere about 1884. The alcoholic extract of the whole plant is used in medicine even to this day though not to the same extent as before. It is also claimed to be a useful remedy in dysentery and colic and has been largely used against worms in children.

Chemical Composition :—Hooper investigated the chemical composition of the drug long ago but could not find any active principle to which the specific properties of the drug could be ascribed. Later, the chemistry of the drug was worked out more thoroughly and gallic acid, quercetin, a new phenolic substance, traces of an essential oil, traces of an alkaloid, etc., have been isolated.

Pharmacological Action :—Marsset (1928) studied the pharmacological action of euphorbia extract and found that it had a depressant action on the heart and respiration and produced a relaxation of the bronchioles by its central action. Dikshit and Kameswar Rao (unpublished) have recently (1931) investigated the action of this drug. They find that the liquid extract of euphorbia (P. D. & Co.) is irritant to the mucous membrane of the stomach, a dose of 2 c.c. of the extract producing vomiting in animals. Intravenous injections do not produce any vomiting showing that the drug is a true local irritant. In animals under urethane anæsthesia, intravenous injections of small doses of euphorbia extract produce broncho-dilatation which is much more prolonged than that produced by small doses of epinephrine. The extract has also been found to have a depressant action on the cardio-vascular system in general; the musculature of the heart is slightly depressed.

Therapeutic Uses :—Euphorbia has been used in Western medicine for a fairly long time but the clinical results obtained do not show that it is likely to be a promising drug. Its pharmacological action so far investigated indicates that its use in spasmodic conditions of the respiratory tract at least is

rational. The drug is often used indiscriminately in all sorts of respiratory diseases and hence the desired effects of the drug are often not manifested. This probably explains the many conflicting reports recorded as to the efficacy of the drug. It appears to have no advantage over many of the well-known remedies used in respiratory affections.

References :—

(1) Marsset, 1928, quoted by Solis-Cohen and Giethen's *Pharmaco-therapeutics*, published by Appleton & Co., p. 1391.

GYMNEMA SYLVESTRE (N.O. Asclepiadeæ)

VERN.—Sans.—*Mesha-sringi* (*ram's horn*) ; Hind. & Beng.—*Merásingi* ; *Chhota-dudhi-lata* ; Tam.—*Shiru-kurunjá* ; Bomb.—*Kavali*.

Gymnema sylvestre is a stout, large, woody, climbing plant which grows abundantly in Central and Southern India and is also distributed to Tropical Africa. The plant has been described in the Hindu Materia Medica as an anti-periodic, stomachic, and diuretic. Susruta describes it as a destroyer of 'madhumeha' (glycosuria) and other urinary disorders. About a hundred years ago, Edgeworth noticed that when leaves of this plant were chewed, the power of the tongue to appreciate the taste of sugar and all saccharine substances was abolished. This was confirmed later by Hooper who discovered that the leaf also had the valuable property of completely removing the taste of bitter articles such as quinine. The loss of these sensations lasts only for one to two hours and not for 24 hours as was stated by Edgeworth. The root of the plant has a reputation among the Hindu physicians as a remedy for snake-bite. The powdered root is generally applied locally to the part bitten and a decoction is administered internally.

On account of its property of abolishing the taste of sugar it has been given the name of 'gur-mar' meaning 'sugar destroying' and the idea has gained ground in some quarters that it might neutralise the excess of sugar present in the body in diabetes mellitus. In Bombay and Central India it has been

used as a remedy against this condition and wonderful results have been claimed.

Chemical Composition :—Hooper (1887) made the first systematic examination of the leaves. He isolated two resins, the resin insoluble in alcohol forming the larger proportion. The resin soluble in alcohol was said to leave a tingling sensation in the throat. There was no tannin. He had also isolated an organic acid said to be a glucoside and to possess anti-saccharine property. It was designated as *gymnemic acid* and the formula $C_{32}H_{55}O_{12}$ was given to it. It was present to the extent of 6 per cent. A new bitter principle, some tartaric acid and calcium oxalate were also isolated.

Power and Tutin (1904) next took up the subject and made a thorough investigation of the leaves. They isolated hentriacontane $C_{31}H_{64}$, quercitol and gymnemic acid. The gymnemic acid was purified and analysed; they showed that it did not possess any anti-saccharine properties and was not a glucoside.

Chopra, Bose and Chatterjee (1928) prepared different fractions from the leaves, isolated the gymnemic acid and prepared a sodium salt of the acid for both pharmacological and clinical trials. They also isolated some enzymes and tested their sugar-hydrolysing action.

Recently, Mhaskar and Caius (1930) have made a detailed chemical investigation of the leaves of *Gymnema sylvestre*. The air-dried leaves yielded, after ignition, 11.45 per cent. of inorganic matter consisting of alkali, phosphoric acid, ferric oxide and manganese. Two hydrocarbons, hentriacontane and pentatriacontane, chlorophyll a and b, phytol, resins, tartaric acid, inositol, anthraquinone bodies and gymnemic acid were also identified. They could not find any water-soluble or alcohol-soluble substance in the leaves which had the property of dissolving glucose *in vitro*, nor any chemical body resembling insulin.

Pharmacological Action :—The action of the enzymes isolated from *Gymnema sylvestre* was studied *in vitro* on both cane sugar and glucose. The sugar solutions were made up to a definite strength and then mixed with the powdered leaves of the plant and also with the enzyme isolated from the leaves. The mixtures were kept in an incubator at 37°C for 48 hours and estimations were made at regular intervals to see if any changes occurred. The following results were obtained:—

(*a*) The reducing substance present in the leaves was found to be 0.37 per cent.

(*b*) In the cane sugar solution mixed with the powdered leaves, hydrolytic action commenced within 2 hours and was completed in 18 hours. The same result was obtained in the cane sugar solution mixed with enzyme isolated from the leaves.

(*c*) The powdered leaves of *Gymnema sylvestre* were found to have an oxidase action on glucose solution and glycolysis occurred which reduced the strength of the glucose solution from 2.3 to 0.66

per cent. in 29 hours. In the enzyme isolated from the leaves no such action was seen.

(*d*) The gymnemic acid was found to have neither hydrolytic nor oxidase action when mixed with cane sugar or glucose solution.

The effect of the drug on the blood sugar was tested on rabbits. The animals used were carefully selected, were all over 1.0 kilogram in weight, and were of the albino Himalayan and the brown Belgian hare types. A quantitative estimation of the initial blood sugar was made and then the drug was given by subcutaneous injection. Two hours after injection the blood sugar was re-examined. Besides pure gymnemic acid, the following fractions were tried and the effect on the blood sugar in animals were recorded :—(1) an aqueous extract of the powdered leaves; (2) an alcoholic extract using 95 per cent. alcohol; (3) an alcoholic extract using 70 per cent. alcohol; (4) sodium salt of gymnemic acid. In none of the animals to whom these fractions were given was there any reduction in the amount of sugar present in the blood. It may be argued that the non-reduction of blood sugar in these rabbits after injection of the various preparations of *Gymnema sylvestre* might be due to the excess of glycogen in the liver of these rabbits, which by being converted into sugar tends to prevent the fall in blood sugar. This may of course be possible in a well-fed animal but to obviate this fallacy the experimental animals were carefully starved from 24 to 36 hours before the test. According to Mhaskar and Caius (1930), however, the leaves cause hypoglycæmia in experimental animals which sets in soon after the administration either by mouth or by injection. This hypoglycæmia has been explained on the assumption that the drug acts indirectly through stimulation of insulin secretion of the pancreas as it has no direct action on the carbohydrate metabolism. These workers are also of opinion that the leaves stimulate the heart and circulatory system, increase urine secretion and activate the uterus.

Therapeutic Uses :—The drug was tried in a number of cases of diabetes mellitus in order to see if it produced any reduction in the amount of sugar present in the blood or urine. All the patients were uncomplicated cases of diabetes and were kept in hospital under strict observation. They were all placed on a fixed diet which was strictly under control. The total quantity of urine passed in 24 hours was carefully collected, measured and a portion of it was examined every day for the quantity of sugar present. The sugar content of the blood was also estimated from time to time, the 'fasting level' of blood sugar being always recorded. The patients were regularly weighed during the course of treatment.

Of the 6 cases treated, 4 were given finely powdered leaves of *Gymnema sylvestre* in doses of one drachm of the powder three times a day. The total intake per day was thus 12 gm. or 180 grains of the powdered leaves. The drug produced no appreciable effect in reducing either the blood sugar or the total daily output of the urinary sugar. The total excretion of sugar became slightly less in some cases towards the end of the treatment, but such variations may be accounted for by the restricted diet alone. The slight variation in the blood sugar may be accounted for in the same way. Administration of insulin to all these cases rendered them sugar free. These findings, however, are not in accord with those of Mhaskar and Caius (1930), who are of opinion that the leaves of *G. sylvestre* in daily doses of 30 to 60 grains (dry leaf) for a period of three months or more may reduce glycosuria, non-amenable to dieto-therapy. It is, however, too early to give any definite opinion and further work is necessary to estimate the real antidiabetic property of the drug.

Summary :—According to the findings of the workers of the School of Tropical Medicine the leaves of *Gymnema sylvestre* contain a substance which has a hydrolytic action on cane sugar. There is also an oxidase-like substance which produces glycolysis in a solution containing glucose. The extracts made from the leaves as well as gymnemic acid and its sodium salts have no effect on the blood sugar when given by subcutaneous injections to rabbits. Powdered leaves and alcoholic extracts prepared from the leaves of *Gymnema sylvestre* have no effect on the blood or urine sugar of patients suffering from diabetes. According to Mhaskar and Caius, the drug appears to be useful in checking glycosuria, when administered in 2 to 4 gm. dosage. Further work is necessary to find out the real value of the drug in diabetes.

References :—

(1) Power and Tutin, 1904, *Pharm. Jour.*, p. 234; (2) Chopra, R. N., Bose, J. P. and Chatterjee, N. R., 1928, *Ind. Jour. Med. Res.*, Vol. XVI, July; (3) Mhaskar and Caius, 1930, *Ind. Med. Res. Memoirs*, March, p. 1.

HEDYOTIS AURICULARIA (N.O. Rubiaceæ)

VERN.—Beng.—*Muttia-lata* ; Nepal.—*Gookee* ; Mar.—*Dapoli, Gaimaril* ; Mal.—*Kudal churiki* ; Kan. & Tulu.—*Nela-nekkare* ; Konkani.—*Bhooya-nankeri* ; Sing.—*Get-kola* ; Malay.—*Mariguti, Kenika* or *Kerukoh batu*.

This plant grows wild in the wet lands of the Western Ghats, throughout the length of the Indian Peninsula from the Konkan to Cape Comorin, extending to Ceylon. It grows also in other parts of India where the rainfall is heavy, *e.g.*, Nepal, Sikkim, the Khasia Hills, Chittagong and Eastern Bengal. In Sikkim the leaves are boiled with rice and used as a food. Beyond this, its use either as an economic product or as a medicinal plant is not referred to in the literature. It is, however, very largely used as a household remedy in South Kanara for all sorts of bowel complaints including diarrhœa and dysentery.

Chemical Composition :—A general examination of the plant by Dey (1930) shows that it contains considerable quantities of tannins, some reducing sugars and glucosides, a small quantity of fixed oil, a fruity-smelling ester and a basic principle precipitated by the common alkaloidal reagents. This basic principle is found to occur in all parts of the plant, the roots containing the largest amount. An assay of the alkaloids shows that the leaves and stems contain 0.1 per cent. and the roots 0.3 per cent. approximately. The air-dried powdered roots which are selected for detailed examination, yield to petroleum ether 1.1 per cent., to ether 2.6 per cent., to alcohol 8.9 per cent. and water 7.7 per cent. of the extracts respectively. The alcoholic extract has been found to contain the whole of the alkaloids. One of the alkaloids has been purified and its hydrochloride has been prepared. The hydrochloride dissolves in water and alcohol with a bright bluish green fluorescence.

Pharmacological Action :—No systematic pharmacological study of the alkaloids has been carried out but it has been shown that they are not very toxic.

Therapeutic Uses :—Bhandarkar (1929-30) has carried out clinical trials with the drug both in the form of a bolus of fresh green leaves and as a decoction of the whole plaint. He claims very satisfactory results in dysenteries with or without *Entamœba histolytica* in the stools. According to him even cases which

proved refractory to emetine injections, stovarsol, bismuth, kurchi, bael, etc., responded to the regular administration of the liquid extract of *Hedyotis auricularia* (Hedaurin). As the drug is not toxic, it can be given to small children without harm. Striking results were also obtained in cases of acute and chronic colitis, and in early cholera. The drug was tried during an outbreak of cholera in the Madras Presidency and it is said to have acted almost as a specific. Other observers, however, are inclined to believe that the drug is not so useful in the treatment of amœbic dysentery as it is claimed to be. Dikshit (unpublished) found that claims made for Hedaurin in the treatment of amœbic dysentery cannot be substantiated. He tried the drug in eight cases of amœbic dysentery with little benefit. The entamœbae were found in fairly large numbers in patients who received Hedaurin for more than four days. The drug may be of use in diarrhœa but here the action in all probability is due to the large amount of tannins present.

References :—

(1) Bhandarkar, P. R., 1929, *Ind. Med. Gaz.*, Vol. LXIV, July, p. 387; (2) Bhandarkar, P. R., 1930, *Publication, Pharmacological Research Institute, Madras;* (3) Dey, B. B., 1930, *Ind. Sci. Congress Abstracts,* Section of Chemistry, p. 24.

HELICTERES ISORA (N.O. Sterculiaceæ)

The East Indian Screw tree

VERN.—Sans.—*Mriga-shinga;* Hind.—*Marori, Marorphali;* Beng.—*Atmora;* Guj.—*Mriga-shiga;* Mar.—*Kevani, Varkati, Dhamani;* Tam.—*Valumbirikai.*

It is a tall shrub or a small tree resembling the common hazel found throughout Central and Western India as far west as Jammu, the Central Peninsula and Ceylon. It has bright red and showy flowers which appear in the rainy season. The capsule has long been employed medicinally in India and is still one of the commonest bazar drugs in most parts of the country. It is chiefly employed in intestinal complaints, entering into most of the prescriptions in the indigenous systems of medicine

for colic, flatulence, diarrhœa, etc. According to Ainslie it is also used by the Hindu physicians as a remedy for offensive sores inside the ear.

Chemical Composition :—The pods were analysed long ago by Dymock but he was unable to find any active principle. Recently, they were re-analysed by the department of chemistry, Calcutta School of Tropical Medicine. Besides a quantity of demulcent substance and tannins nothing of any note could be detected.

Therapeutic Uses :—The pods are used even to this day in some parts of India, specially the Bombay Presidency, in the treatment of chronic dysentery. They are roasted and are mixed with a number of other ingredients. Some of the patients who have tried them bear testimony to the fact that the symptoms are considerably ameliorated. Apart from this, no definite improvement in the microscopic characters of the stools could be found. In proved cases of amœbic dysentery, it does not appear to bring about any marked improvement.

HERPESTIS MONNIERA (N.O. Scrophularineæ)

VERN.—Sans.—*Brahmi* ; Hind.—*Barambhi* ; Beng.—*Brihmi-sák* ; Mar.—*Nir-brami* ; Tam.—*Nirbrami* ; Tel.—*Sambrani-chettu*.

This is an annual creeping plant, found in moist places near streams or on the border of tanks throughout India. The root as well as the stalks and leaves are used in the Hindu medicine. It is considered to be a nerve tonic, and useful in insanity and epilepsy. It has been frequently mistaken for *Hydrocotyle asiatica* (N.O. Umbelliferæ) known in the vernacular as 'thol-kuri'; both these plants are known by the name of 'brahmi' in many places.

Chemical Composition :—Samples of the drug from different sources were analysed by Bose (1931). It was found that all the specimens contained an alkaloid in varying proportions. The alkaloid could be extracted by macerating the drug with ether-chloroform mixture in the cold. In the case of rectified spirit, prolonged maceration was required for complete exhaustion. Only about 0.01 per cent. of the alkaloid could be isolated by treatment with boiling water but when treated with a

mixture of glycerol and water, a larger quantity (0.02 per cent.) of the alkaloid could be isolated.

Pharmacological Action :—The alkaloid obtained from *H. monniera* for which the name 'brahmine' is suggested, has been studied by Bose and Bose (1931). They find that it is highly toxic. Frogs are killed within 10 minutes with a dose of 0.5 mgm. per 100 gm. body weight. Rats and guinea pigs are killed within 24 hours with a dose of 25 mgm. per kilogram body weight. A dose of 0.5 mgm. per kilogram body weight of cat produces a fall of blood pressure. In smaller doses, however, there is a slight rise of blood pressure due to vaso-constriction and stimulation of the cardiac muscles. The respiration is stimulated in small doses. Plain muscles like that of the small intestines, uterus, etc., are stimulated in dilutions of 1 in 200,000 to 1 in 500,000. In therapeutic doses, the alkaloid resembles strychnine in action.

Therapeutic Uses :—Bose has used powdered dried leaves of the Brahmi plant with very satisfactory results in cases of asthenia, nervous breakdown and other low adynamic conditions. According to him, the drug has many advantages over strychnine. It is less toxic than strychnine and will not produce the reflex irritation which is often noticed if nux vomica or strychnine is administered for a long time. Furthermore, *Herpestis monniera* is a direct cardiac tonic whereas strychnine only indirectly stimulates the heart. In view of the above findings, a further trial of the drug seems very desirable. The quantity of the alkaloid, however, appears to be very small in the leaves.

References :—

(1) Bose, K., & Bose, N. K., 1931, *Jour. Ind. Med. Assoc.*, Vol. I, October.

HOLARRHENA ANTIDYSENTERICA (N.O. Apocynaceæ)

Kurchi, Conessi or Tellicherry Bark.

VERN.—Sans.—*Kutaja* ; *Kálinga* ; Hind.—*Karchi*, *Kura* ; Beng.—*Kurchi* ; Bomb.—*Pandhra-kúra* ; Tam.—*Kashappu-vetpalarishi* ; Punj.—*Kewar*, *Kúra*.

Holarrhena antidysenterica is a small deciduous tree with white flowers. It is a native of the tropical Himalayas, going up to an altitude of 3,500 feet ; it is also found throughout the dry forests of India, even as far south as Travancore. It is

also met with abundantly in Assam and in the United Provinces. The seeds are called 'indrayava' or 'Indra's seeds' in Sanskrit ; in Persian it is known as 'indar-jave-talkh' and it is well-known in Arabian medicine.

The plant is fabled to have sprung from the drops of 'amrita' or water of life which fell on the ground from the bodies of Rama's monkeys, which were restored to life by the God Indra. This plant was often confused with another of the same family called *Wrightia tinctoria* which is medically inert. Linnæus was originally responsible for this confusion but it was rectified by Brown (1809), who revised the whole of the Apocynaceæ family. Although differentiation between *Holarrhena antidysenterica* and *Wrightia tinctoria* has thus been made for nearly a hundred years, yet they are often mistaken for one another and this fact probably accounts for the drug having fallen into disrepute. *Wrightia tinctoria*, however, has white jasmine-like flowers with a fragrant odour, while the flowers of Holarrhena are odorless. Further, the *Wrightia tinctoria* bark can be easily identified from its reddish brown colour and its smooth appearance as compared with the Holarrhena bark, which is thicker and is of a dirty white or buff colour and has a markedly bitter taste. The seeds of Holarrhena resemble oats; they are very bitter and are contained in long follicles about the thickness of a quill. They have a tuft of hairs on the end most remote from the foot-stalk, whilst in the Wrightia seeds the tuft is on the end next to the foot-stalk.

A kind of indigo dye is extracted from the leaves, and they are used as fodder in certain parts of the Punjab. The wood is white, soft, and even-grained and is used for carvings and for making furniture. The bark of both the stem and the root and the seeds are amongst the most important of the medicines of the Hindu Materia Medica. The bark is considered to be a powerful antidysenteric, while the seeds are said to have astringent, febrifuge, antidysenteric and anthelmintic properties. In the Arabian medicine the seeds are considered carminative and astringent, valuable in pulmonary affections, tonic, lithontriptic and aphrodisiac. Combined with honey and saffron they are made into pessaries which are supposed to favour conception. The pharmacopœia of India classed *H. antidysenterica* amongst the non-official remedies but reported very favourably on its therapeutic qualities. The Hindu physicians use it in the form of a fluid extract or expressed juice of the fresh plant, a compound decoction and a confection prepared from the bark and the seeds are often given in dysentery with beneficial results.

Chemical Composition :—A large volume of chemical work has been done on the bark and seed of Holarrhena both in Europe and in India. The European workers have chiefly studied *H. congolensis* while the Indian workers investigated the *H. antidysenterica* grown in India. The total alkaloidal content of the bark has been variously reported

by different workers so far as the Indian variety is concerned. Caius and Mhaskar (1927) found only 0.025 per cent. of the alkaloid in the seeds and 0.22 per cent. in the bark. Recent researches by Ghosh and Ghosh (1928) show that the alkaloidal content is much higher and averages about 1.2 per cent. of the total constituents. This is a fairly high figure and shows that it will be quite economical to prepare salts of the alkaloids on a commercial scale. .

Haines (1858) first isolated an alkaloid which he named 'conessine' from the commercial name of the bark—'conessi bark'. Ram Chandra Dutt (1881) isolated the total alkaloids which he named 'kurchicine' after the vernacular name of the plant. Warnecke (1886), and Kanga, Aiyar and Simonsen (1925) isolated pure *conessine* from the seeds. Pyman (1919) isolated *conessine* from the bark of *Holarrhena congolensis* together with a new alkaloid which he termed *holarrhenine*. Ghosh and Ghosh (1928) have shown that, besides conessine, there are two other alkaloids present which have been designated as *kurchicine* and *kurchine* respectively. The alkaloid termed kurchine is characterised by having a low melting point 75°C, and it is the most abundant alkaloid present in the bark.

More recently, Ghosh and Bose (1932), working in the School of Tropical Medicine, isolated the alkaloids kurchine and kurchicine in a pure state. They have made a detailed study of the chemical composition of the free bases and of many of their important salts. kurchine, the base which occurs in the largest amount, is shown to have the formula $C_{23}H_{38}N_2$ and kurchicine is shown to have the formula $C_{20}H_{36}ON_2$. They are thus different from conessine and holarrhenine found in African Holarrhena. Haworth (1932) has isolated Kurchicine from the seeds and his work confirms the above formula.

Kurchi Bismuth Iodide and its Preparation :—This is an orange-red powder containing about 27 per cent. total alkaloids and 22.85 per cent. of bismuth. It is sparingly soluble in dilute hydrochloric acid, water and alcohol. (1 gm. base=3.5 gm. K.B.I. approx.).

The total alkaloids are dissolved in dilute hydrochloric acid and then treated with Dragendorff-Kraut's reagent with constant stirring until there is complete precipitation. The orange-red precipitate is allowed to settle and then filtered and washed thoroughly with distilled water. The precipitate is collected and dried at ordinary temperature.

Dragendorff-Kraut's Reagent :—80 gm. basic bismuth nitrate is dissolved in 200 gm. nitric acid (sp. gr. 1.18) and then poured into a concentrated aqueous solution of 272 gm. potassium iodide and diluted to a litre. (*N.B.*— For K. B. I. we found it better to use the solution diluted to 500 c.c.).

PHARMACOLOGICAL ACTION OF THE ALKALOIDS :—Kiedel (1878) found that conessine depressed the centres in the brain for conscious sensation and for the initiation of voluntary

movements. Burn (1915) stated that conessine and holarrhenine are cardiac poisons as perfusion of the isolated heart with them causes the heart to come to a standstill. Giemsa and Halberkahn, on the other hand, did not find similar effects. It would appear from these that the pharmacological action of the holarrhena alkaloids required further careful study and this was undertaken by the author. The results of this work are briefly summarised below.

CONESSINE :—*Action on Protozoa* :—Brown (1924) appears to have been the first worker to study the amœbicidal properties of conessine. He tested the action of the alkaloid on cultures of a pond amœbae and found that it had distinctly lethal effects on this organism. When it was incorporated with the culture medium in strengths of 1 in 1,000,000 it inhibited their growth. Experiments with mice showed conessine to be 50 per cent. less toxic than emetine but its subcutaneous administration in medicinal doses produced local necrosis. On the other hand, he found that it can be safely given by mouth in large doses. Although the alkaloid exerted some toxic action *in vitro* on the bacilli of the dysentery group, it did not appear to produce any effect in bacillary dysentery in man in ordinary therapeutic doses. Henry and Brown (1923) while testing the tannins obtained from the *H. antidysenterica* bark and also those from ipecacuanha against the free-living ciliate protozoon, Glaucoma, found both of them to be highly toxic to this ciliate. Chopra and his associates (1927) showed that conessine killed free-living amœbae, proteus and limax, in dilutions of 1 in 280,000. Its action on the vegetative forms of *E. histolytica* was tested on the dysenteric stools of experimentally-infected kittens. In mucus flakes in such stools motile amœbae were killed in dilutions of 1 in 280,000 in 8 minutes in the presence of an alkali and in 18 minutes in the absence of alkali, as compared with 1 in 200,000 of emetine. Conessine produced little effect upon *Trichomonas hominis* but was markedly lethal to the coprozoic flagellate protozoon, *Bodo caudatus*, killing it in dilutions of 1 in 280,000 as compared with 1 in 20,000 of emetine.

Local Effects :—Subcutaneous or intramuscular injections of conessine salts are painful and set up a marked œdema and swelling of the area round the site of injections. There are signs of congestion and hyperæmia of the tissues at the site of injection, but no hæmorrhage or necrosis of tissues was observed even when a 6 per cent. solution was injected. The effects were visible a few hours after the injection, began to show signs of resolution after 24 hours and disappeared almost entirely after 48 hours.

Alimentary System :—Conessine has a bitter taste. When given by the mouth it appears to have a depressing action on the digestive

ferments. The action of ptyalin, pepsin and trypsin is inhibited by it. The preparations of *H. antidysenterica* should, therefore, be preferably given two hours after meals so that the digestion is as little interfered with as possible. Intravenous injections of conessine stimulate the peristaltic movements of animal intestines *in situ*. The tone of the muscle of isolated pieces of gut is increased. This is probably the reason why preparations made from the bark produce looseness of the bowel.

Circulatory System :—In large doses, this alkaloid has a depressant action on the auriculo-ventricular bundle in the frog, the heart beats being markedly slowed and there being one beat of the ventricle to 3 to 5 beats of the auricle. Later, the auricles beat quite independently of the ventricles, complete heart block being established. Turtle's heart perfused with conessine showed marked slowing and decrease of amplitude of the beats. In the mammalian heart, small doses produced a temporary increase in both auricular and ventricular contractions, but this was quickly followed by depression. In the cat the heart was visibly slowed after 2 mgm. given intravenously. When repeated injections were given the heart became irregular. After large doses a definite heart block is produced, fibrillation and finally stoppage of the ventricles takes place. Isolated mammalian heart is depressed by conessine in such dilutions as 1 in 60,000 to 100,000. Conessine appears to act on the fibres of the auriculo-ventricular bundle causing slowing and increase of diastolic pause, arrhythmia and finally heart block. Intravenous injections of conessine invariably produce a marked and persistent fall of blood pressure after a slight momentary rise. With very small doses such as 0.25 mgm. to 0.5 mgm., there is a tendency to recovery after the fall but with higher doses the fall is more or less persistent, the blood pressure not regaining its normal level for a very long time.

Respiratory System :—There is a preliminary stimulation followed by slowing. With large doses, the respirations become slow and shallow and finally stop earlier than the heart.

Nervous System :—Conessine has a well-marked narcotic action on frogs, 15 mgm. injected into the lymph sac of an animal producing paralysis and loss of all reflexes in 10 to 20 minutes. In mammals narcosis is not produced even after large doses. A 5 per cent. solution dropped into the eye of a rabbit produced irritation followed by complete anæsthesia in 6 to 12 minutes.

TOTAL ALKALOIDS :—The pharmacological action of the other two alkaloids of *H. antidysenterica* is under investigation. The action of the total alkaloids has been carefully investigated in view of the powerful action of conessine on the heart muscle. If the action of the total alkaloids on the heart was the same, it would make one hesitate to administer them in large doses. Any limitation of dosage would defeat the end we have in view, *i.e.*, to attain a concentration of these

alkaloids in the large intestine, sufficient to kill the amœbae in spite of the acidity that was present in the gut contents or in the surface tissues.

(*a*) *Circulation* :—Small doses, 2 mgm. injected intravenously into the saphenous vein of a cat weighing 2 kilos, caused a persistent fall of blood pressure, but without any alteration in the intensity or frequency of the heart beat. In much larger doses, there was slowing of the heart beat. Perfusion through the isolated heart rarely showed any effect on the frequency or force of the contraction. Doses of 2.5 mgm. in a cat of 2 kilos showed no alteration in the auricular and ventricular contraction as seen in myocardiographic tracings. Although there is a marked rise in pulmonary pressure with conessine and holarrhenine, the rise is only slight when the total alkaloids are injected into the animal.

(*b*) *The Volumes of Various Organs and Structures in the Body* :—The limb volume and that of the liver, spleen and kidney were all decreased after intravenous injections of the total alkaloids, indicating that vaso-constriction was occurring at these sites. On the other hand, there was a very marked increase in the intestinal volume with complete inhibition of intestinal movements. From these results it can be reasonably concluded that the fall in blood pressure is due to dilatation of the intestinal vessels and to a lesser extent to engorgement of the lungs.

(*c*) *Local Effects on Intramuscular or Subcutaneous Injections* :—When a 6 per cent. solution was injected into the tissues no hæmorrhage or necrosis was observed but a good deal of œdema at the site of the injection. The œdema was most marked after 4 hours and began to disappear after 24 hours and disappeared completely within 48 hours after the injection; hyperæmia and œdema were caused most probably by the acidity of the salt of the alkaloids. 1 to 2 grains of the salts of the total alkaloids give rise to a certain amount of pain. There were no signs of bruising (hæmorrhages) as is seen with emetine nor necrosis as with quinine.

(*d*) *On the Uterus* :—The total alkaloids have very little effect on the excised uterus or on the uterus *in situ* except in strong concentrations which it is impossible to attain in the circulating blood. The alkaloid kurchine with a low melting point is the most powerful, causing contractions in a concentration of 1,50,000. Most alkaloids circulate in the blood at a concentration of 1 in 150,000 to 1 in 500,000. Therefore, these alkaloids would have little or no effect if given to a pregnant woman.

(*e*) Even 2 grains of the total alkaloids repeatedly given intramuscularly do not produce the bodily and mental depressions as are observed with emetine.

From the clinical experiences of nearly two years of the author the following facts can be stated regarding these

alkaloids. There is no emetic or depressant effect when 20 grains of the kurchi bismuth iodide are given daily for 10 or even 15 days. The pulse remains normal in frequency, tension and rhythm. There is no alteration in the heart sounds, even in a case of cardiac disease. The drug does not produce irritation of the alimentary canal and diarrhœa as is the case with emetine. If diarrhœa does occur, there is generally a reason such as a co-existing bacillary infection by the *B. dysenteriæ* (Flexner or Strong).

Therapeutic Uses:—(*a*) *Bark, Seeds and their Preparations*: The seeds are considered to be serviceable in dysentery, diarrhœa, fevers, flatulence, bilious affections, etc. In the treatment of hæmorrhoids they are given in the form of a decoction made with milk and are regarded as most efficacious. 'Indrayava', powdered or infused in warm water, has been found very useful in mild forms of dysentery complicated with worms in children. The bark, however, has enjoyed much more reputation than the seeds. It has often been mentioned in the Hindu medicinal books such as 'Susruta', 'Bhavaprakasa' and the 'Nighantu' and in all these books it has been awarded a very high place amongst the known anti-dysenteric remedies. That it is really a valuable remedy for dysenteric affections has been borne out by the statements of many medical practitioners both Indian and European. As early as 1881 R. C. Dutt recorded clinical cure of several cases of acute and chronic dysentery by the administration of extract made from the bark. Tull Walsh (1891) referred to the use of the bark with satisfactory results. Kanai Lal Dey (1896) was so convinced of its therapeutic value that he advocated its inclusion in the British Pharmacopœia. The Indigenous Drugs Committee, seeing the enthusiastic reports given in the Indian Pharmacopœias, decided to determine the real merits of the kurchi bark in the treatment of dysentery. The procedure adopted by the committee, was to issue standardised preparations of the bark extract to various government hospitals and dispensaries and to collect reports regarding its efficacy in various types of bowel complaints. Reports received from time to time were very encouraging and left the impression in the minds of the members

of the Committee that the medicine has indeed got some real anti-dysenteric properties. Waring said that it is almost a specific in chronic dysentery and all varieties, whether acute or chronic and whether complicated with fever or uncomplicated, are benefited by it. Koman of Madras reported that in the dysenteries of both children and adults, the liquid extract of kurchi bark gave very satisfactory results in almost every case.

H. antidysenterica has lately been tried somewhat extensively in the treatment of amœbic dysentery. The remedy was at first used in the form of an infusion of the root bark ; this, however, is very bitter and most unpalatable. Burroughs Wellcome & Co. have put 'tabloids' made from the bark on the market and in this form it is easily taken and has been combined with emetine treatment with beneficial results. According to Knowles (1928), the simultaneous administration of emetine hypodermically and tabloid of kurchi bark orally is of marked value in the treatment of amœbic dysentery.

Caius and Mhaskar (1927) had satisfactory results with powdered whole bark. Knowles and others (1928) tried kurchi orally in 16 patients ; 10 patients were put on liquid extract of kurchi and the remaining 6 patients on 'tabloids' of kurchi bark (B. W. & Co.). The ratio of probable cures to failures in his series is surprisingly high for so simple a remedy ; the treatment involves no injections and has the additional merit of not developing toxic symptoms. With the 'tabloid' product, the dose could be pushed to 60 grains a day without discomfort. With the liquid extract, 10 drachms a day can be given for 10 days without the patient complaining of any symptoms. In the treatment of acute cases, the improvement was less rapid than emetine but cure appeared to be much more permanent.

A standardised extract made from the bark is now on the market, one drachm (4.0 c.c.) containing roughly a grain of the total alkaloids. The author has used this extract in doses of 2 drachms 3 times a day for 4 to 5 weeks either by itself or in combination with *Plantago ovata* (Ispaghula) in the treatment of very chronic cases of amœbic dysentery with beneficial results. No untoward symptoms or cumulative toxic effects

were produced. Even in patients suffering from bacillary dysentery the symptoms are markedly benefited.

Besides the antidysenteric properties of Holarrhena, a firm belief exists in the United Provinces that the bark has very good antimalarial properties. With a view to confirming the truth of the statement large doses of bark extracts as well as of the alkaloids were given to patients suffering from amœbic dysentery and who had coexisting malaria ; in none of these cases was any effect produced either in the clinical symptoms of the disease or on parasites in the blood.

(*b*) *The Alkaloids* :—The different active principles obtained from the bark and seeds have been tried from time to time by individual workers in the treatment of dysentery. Ghosh (1880) prescribed kurchicine both in the form of powder and in solution. The powder was administered in dosage of 2-5 grains and the solution was prepared by dissolving 2 grains of the alkaloid in one ounce of water by addition of a little acetic acid. From his experience and that of Coates who treated 7 cases, he declared that kurchicine was a valuable antiperiodic in no way inferior to the cinchona alkaloids.

Conessine has been tried in cases of dysentery by many workers. Willmore (1923) treated 2-3 cases refractory to emetine with injections of conessine without favourable results. Caius and Mhaskar (1927) administered an aqueous solution of conessine hydrochloride (10-20 mgm. of alkaloid per ounce) three times a day, the total amount of the drug administered being 30 ounces daily. Ten cases were treated in all, of which 2 were actually cases of amœbiasis. In daily doses of 60 mgm. continued for 6 days no toxic symptoms were observed. Six of these cases proved refractory but the amœbic cases did well. Recently, Knowles and his colleagues (1928) tried conessine intramuscularly in 9 cases showing vegetative *E. histolytica* in their stools in the Carmichael Hospital for Tropical Diseases. The stools were examined in most cases for 10 consecutive days after the treatment was over and this was taken as a criterion of cure. The results obtained were not very promising even in cases where the drug was used in 2 grains doses daily.

The author, as the result of his researches from pharmacological point of view, commenced using the total alkaloids of *Holarrhena antidysenterica*—'kurchi alkaloids'—in the treatment of acute amœbic infections by intramuscular injections. The results were very gratifying and showed that in acute cases, the total kurchi alkaloids were as powerful as emetine in their immediate effect on the symptoms as well as in their curative value, in such doses as 1 grain daily. The intramuscular injections produced inflammation and swelling of the parts and were accompanied by considerable pain in some cases. They did not, however, produce any of the general toxic effects usually met with when emetine injections are given, especially for prolonged periods. Some of the patients complained of a momentary sensation of flushing of the face and a feeling of heaviness in the head soon after the injection was given, but these quickly passed off.

Intramuscular injections of the total alkaloids, although they were effective against acute amœbic dysentery, did not produce very satisfactory results in chronic and long-standing cases. It was, therefore, considered advisable to give the alkaloids by mouth in view of the facts that preparations of *H. antidysenterica* bark given by the oral route were much more effective in chronic cases. This led to the preparation of a bismuth iodide compound of the total alkaloids.

Kurchi Bismuth Iodide:—Dale and Dobell (1917) first showed the value of emetine bismuth iodide in the treatment of chronic amœbic infections, and got constant curative results by this method of treatment. Their results hold good when dealing with young soldiers in England, but the drug is not so successful when dealing with the class of cases met with in India. Knowles (1928) clearly brought out this point in his paper by the numerous failures he had with all the different combinations of emetine he used in the treatment of these chronic cases.

Acton (1921) first pointed out the importance of the hydrogen-ion concentration (Ph) of the solution on the behaviour of *Paramœcium caudatum* towards the cinchona alkaloids. He found that both emetine and quinine were ten times more powerful in an alkaline substrate of Ph of 8 than in an

acid substrate of Ph of 6. The stools of patients suffering from acute amœbic dysentery are markedly acid in reaction and the failures in treatment with emetine were considered to be due to the alkaloid not being in sufficient concentration in the acid content of the large gut. The stools in these cases had usually a Ph of 5 to 6 ; this meant that emetine would have to be in a concentration of 1 in 8,000 to 1 in 10,000 to be effective on the amœbae in this substrate. Attempt was therefore made to remedy this acidity of the bowel by giving large doses of bismuth carbonate by the mouth as advocated by Deeks. But this treatment was not successful. According to Acton the high acidity of the stool in dysentery cases is due to mixed infection of the gut. The common organisms met with in the stools of such patients are streptococci, *B. dysenteriæ* (Flexner and Strong) and lastly the acid-producing organisms such as *B. lactis ærogenes*, *B. acidi lactici*, etc. A course of autogenous vaccines given to these patients before the emetine bismuth iodide treatment was given greatly increased the cure rates. A combination of vaccine and emetine therapies, however, is not at present very practical in India as the preparation of vaccines requires well-equipped laboratories which are available in large cities only. To obviate this difficulty, a bismuth-iodide compound of kurchi alkaloids was prepared ; as the total alkaloids of *H. antidysenterica* were shown to have a powerful action on *E. histolytica* it was thought that such a combination would be a distinct advantage. These alkaloids had no emetic or irritant action on the gut and did not depress the heart. It was, therefore, possible to give them in much larger doses than is feasible with emetine. Moreover, such a compound would remain undissolved till it came to the large intestines. As much larger doses of the total alkaloids in this form could be given, a greater concentration would be obtained in the gut, sufficient to overcome the hindering action of the acidity of the large intestine. Such doses as 10 grains of the bismuth iodide, containing about 27 to 30 per cent. of the alkaloids, are well tolerated morning and evening for periods ranging from 10 to 20 days. There is no appreciable effect on the pulse rate or blood pressure. There is no alteration in the heart sounds

even in organic heart diseases. The depressing, emetic or intestinal irritation that is usually produced by emetine was not observed. No cumulative effects are produced as are observed in the case of emetine. This drug has now been tried on a large series of cases of chronic amœbic dysentery and the results obtained compare very favourably with any of the other drugs used. It is hoped that the advent of these alkaloids will mark a definite advance in the treatment of chronic amœbiasis. The action of the alkaloids in amœbic hepatitis is doubtful. They do not appear to have such beneficial effects in non-suppurative and suppurative hepatitis of amœbic origin as emetine has.

It may be mentioned here that while the total alkaloids and their preparations from some batches of the bark gave remarkable results in clearing up very chronic cases of amœbic dysentery, others proved unsatisfactory. The factors concerned have not been fully worked out and are still under investigation, but it is probable that maturity of the bark or changes in the alkaloids themselves of the nature of racemisation, oxidation, etc., while they are still in the bark may be responsible factors. When these are cleared up and a uniformity of action is obtained, an effective remedy will be found for chronic amœbic dysentery and the demand for the bark will be very large.

Summary:—In the laboratory and clinically the total alkaloids obtained from *H. antidysenterica* bark have a most remarkable action against acute and chronic forms of amœbic infections of the gut. The alkaloids can be given in large doses and without producing depressant, emetic, irritative or cumulative effects. They are much less toxic than emetine. In acute amœbic dysentery intramuscular injections of 1 grain of total alkaloids produce a cure at least as quickly as emetine. They produce a certain amount of local reaction, pain and swelling which pass off in 24 to 48 hours. In chronic cases 10 grains of the alkaloids twice daily for 10 days eradicate the infection in a large number of cases. In very persistent cases, a course of 15 to 20 days is given according to the severity of the case. Such prolonged use produces no toxic effects and untoward symptoms. A standardised extract of the bark containing roughly ½ grain of the alkaloid in one drachm (4.0 c.c.) is now

on the market. In chronic cases it can be used for 4 to 6 weeks in doses of two drachms three times a day either by itself or in combination with *Plantago ovata* (Ispaghula). A bismuth iodide compound of kurchi alkaloids has also been prepared. This preparation promises to be a valuable treatment for chronic amœbic affections of the bowel particularly in the tropics. As *H. antidysenterica* grows abundantly in the submontane areas all over India from the Himalayas to Travancore it is easily procurable and is cheap. Further the alkaloid content of the bark is high and it is hoped that the advent of this drug marks a definite advance in the treatment of amœbic infections of the bowel in this country.

References :—

(1) Pyman, F. L., 1919, *Jour. Chem. Soc.*, Vol. 115, p. 163; (2) Henry, T. A. and Brown, H. C., 1923, *Trans. Roy. Soc. Trop. Med.*, Vol. XVII, p. 378; (3) Henry, T. A. and Brown, H. C., 1923, *Trans. Roy. Soc. Trop. Med.*, Vol. XVII, p. 61; (4) Koman, 1924, *Madras Govt. Report on Indigenous drugs;* (5) Chopra, R. N., Gupta, J. C., David, J. C. and Ghosh, S., 1927, *Ind. Med. Gaz.*, Vol. LXII, March; (6) Caius, S. J. and Mhaskar, K., 1927, *Ind. Med. Res. Memoir*, No. 6; (7) Knowles, R. and others, 1928, *Ind. Med. Gaz.*, Vol. LXIII, p. 455; (8) Ghosh, S. and Ghosh, N. N., 1928, *Jour. Ind. Chem. Soc.*, Vol. V; (9) Acton, H. W. and Chopra, R. N., 1929, *Ind. Med. Gaz.*, Vol. LXIV; (10) Chopra, R. N. and De, N., 1930, *Ind. Med. Gaz.*, Vol. LXV, July; (11) Ghosh and Bose, 1932, *Arch. der. Pharm.* Vol. 270, Feb.; Haworth, R. D., 1932, *Jour. Chem. Soc.*, p. 631.

MALLOTUS PHILIPPINENSIS (N.O. Euphorbiaceæ)

Kamala ; Rottlera.

VERN.—Sans.—*Kapila, Rechanaka ;* Hind.—*Kambila, Kamalá ;* Beng.—*Kamila ;* Punj.—*Kamal ;* Bomb.—*Shendri ;* Tam.—*Kapli ;* Tel.—*Kunkuma.*

Glandulæ rottleræ or Rottlera or Kamala consists of minute red glands and hairs of the fruit of an evergreen tree, *Mallotus philippinensis,* belonging to the Spurge family. It is a small evergreen shrub which is widely distributed throughout the tropical parts of Asia and Australia. It is collected in large quantities in Indo-China and is exported to Europe. The plant grows throughout the plains of India and Ceylon. In Orissa,

Bengal and Bombay it grows abundantly and it has been used as a dyestuff for centuries. The Arabian physicians called it 'wars' or 'wuras' and knew its anthelmintic properties as far back as the 10th century. It was introduced into Europe only sixty years ago, and at one time it gained a considerable reputation as an anthelmintic. It was included in the British and United States Pharmacopœias, but further experience showed that its action was uncertain and it was discarded. According to Waring it has little or no effect on intestinal parasites other than tapeworms. The drug as sold in the bazar is highly adulterated.

Chemical Composition :—Kamala is a beautiful purplish-red or brick-red powder having no taste or odour. It is insoluble in cold water and only slightly soluble in boiling water, but it is freely soluble in alkalies, alcohol and ether, forming a deep red solution. A large amount of work has been done on the chemical composition of this substance and a number of substances have been isolated. The most important constituent is a brownish red resin composed of a crystalline substance called *rottlerin*, $C_{33}H_{30}O_9$. It occurs in reddish yellow, laminar plates which are readily soluble in ether but insoluble in water. When acted on by hot caustic alkalies, rottlerin yields methyl-phloroglucin and by reduction with zinc powder and soda, dimethyl phloroglucin. Filicic acid and kosotoxin also yield these substances. Besides rottlerin there is another substance called *isorottlerin* which is probably impure rottlerin. The drug also contains a yellow crystalline substance and a yellow and a red resin and wax. It contains traces of a volatile oil, starch, sugar, tannin, oxalic and citric acids.

Pharmacological Action :—Semper (1910) tested the action of this drug on frogs, tadpoles and worms and found that it had distinctly toxic effect on these animals. The symptoms produced were similar to those produced with male fern, though they were of a comparatively mild character. The paralysing effect was very remarkable. The drug irritates the gastro-intestinal tract and even in therapeutic doses produces considerable nausea, and increases the peristaltic movements of the intestine; it therefore acts as a good cathartic. Experiments on dogs show that it is absorbed very slightly from the gastro-intestinal tract.

Therapeutic Uses :—The drug is used to remove ascaris and threadworms and is generally given without any preliminary preparation, dietary or otherwise. The powder is mixed with milk, curd or honey or dissolved in an aromatic water before it is swallowed. In doses of 2 to 3 drachms, it may cause nausea

and griping and free purging is produced so that no after purgative is necessary. There are as a rule no after-effects. Caius and Mhaskar (1923) tried it in a series of cases and found it to be useless against hookworms, roundworms and whipworms, although earlier observers have claimed it to be a good vermifuge against these worms. Good Kamala powder is, however, said to act well against tapeworms. Probably its effect would be enhanced if it is given after preliminary preparation such as dieting and purgation, as is the case with male fern. It is a mild drug and is indicated in children and debilitated individuals in whom extract of filix mas is not advisable.

References :—

(1) Chopra, R. N., and Chandler, A. C., 1928, *Anthelmintics and their Uses in Medical and Veterinary Practice*, William Wilkins & Co.

MELIA AZADIRACHTA (N.O. Meliaceæ)

The Neem ; Indian Lilac.

VERN.—Sans.—*Nimba, Arishta* ; Hind.—*Nim, Nimb* ; Beng.—*Nim, Nimgachh* ; Bomb.—*Nim, Bál-nimb* ; Tam.—*Vembu* ; Tel.—*Vepa* ; Punj.—*Nim*.

Melia azadirachta is a large evergreen tree, 40 to 50 feet in height, common throughout the greater part of India and Burma. It is frequently planted as a homestead or avenue tree as it is believed to purify the air. Almost every part of this tree is used for medicinal purposes in India. The bark, leaves and fruit have been used in the Hindu medicine from antiquity and are mentioned in the earliest Sanskrit medical writings, *e.g.*, 'Susruta'. The bark and the leaves are of particular interest from the medicinal point of view. The bark is regarded as bitter, tonic, astringent and useful in fever, thirst, nausea, vomiting and skin diseases. The bark exudes a clean bright amber-coloured gum which is collected in small tears or fragments. It is considerably esteemed medicinally as a stimulant. The leaves are reputed from very ancient times to be useful in skin conditions. As an external application to ulcers and skin diseases, neem leaves are used in a variety of forms such as poultices, ointments and liniments. The fruits are described as

a purgative and emollient and are useful in the treatment of intestinal worms, urinary diseases, piles, etc. The dried flowers are also used as a tonic after fever ; under the name 'pancha-amrita', a medicine is prepared which contains the flowers, fruits, leaves, bark and root of the tree.

Chemical Composition :—Margosa bark was chemically examined first by Cornish (1856) who found that it contained a bitter alkaloid occurring in long white needles to which he gave the name of *margosine* but which was obtained only in minute quantities as a double salt of margosine and soda. According to Broughton (1873) the bitter principle present in the bark consists of a resin which it is very difficult to obtain in a state of purity. This worker did not obtain any definite reaction for the presence of an alkaloid.

A fixed bitter oil occurs in the seeds to the extent of 31 per cent. and can be extracted by boiling or by pressure. This oil is deep yellow in colour and has a strongly disagreeable acrid taste. Warden examined the oil and found that it had a specific gravity of 0.9235 at 15.5°C ; at about 10° to 7°C it congealed without losing its transparency; the oil contained free and volatile fatty acids. After standing for about 36 hours, the freshly-expressed oil deposited a white sediment which on microscopical examination was found to be amorphous in character. The colour reactions of the margosa oil were not characteristic. Though no attempt at separating the fixed fatty acids was made, they probably consist of a mixture of stearic and oleic acids with a small amount of lauric acid.

Roy and Chatterjee (1921) analysed the oil and found the following constituents :—

(1) Sulphur 0.427 per cent. (2) A very bitter yellowish substance was obtained from an alcoholic extract of the oil. There is every probability that this substance is an alkaloid but this point has not been finally settled. (3) Resins. (4) Glucosides, indefinite. (5) Fatty acids.

Margosic Acid and its Salts :—An acid which has been named 'margosic acid' was prepared from the oil by Roy and Chatterjee (1917-18) in the following manner :—

Steam-distilled neem oil was saponified with caustic soda dissolved in alcohol. The alcohol was removed by distillation and then the potash soap formed was decomposed by treatment with excess of dilute hydrochloric acid. The liquid was then boiled and margosic acid separated as an oily layer which solidified on cooling. The acid was removed and washed repeatedly with water till it was free from hydrochloric acid. It was again melted on the steam bath and then the upper oily layer was carefully separated; on cooling, margosic acid was obtained as a yellow mass.

The sodium and potassium salts were prepared by neutralising the acid with requisite quantities of caustic soda and caustic potash solutions respectively and evaporating them to dryness on the steam bath and finally in the desiccator over sulphuric acid. The salts are nearly white in colour and are soluble in water. They are extremely bitter to the taste.

Watson and his co-workers (1923) consider that the objectionable odour of neem oil is chiefly due to organic sulphur compounds which are slightly volatile. On prolonged steam distillation of the oil a volatile sulphur compound slowly distils over and collects on the condensed water. A bitter principle, about 200 times as bitter as the original oil was separated by these workers. The ultimate analysis of the bitter substance showed that it consists of 2 different portions—an amorphous and a crystalline substance. The crystalline substance has been termed 'margosopicrin'.

Dutt and his co-workers (1930), however, consider that the odorous element in the oil consists of an evil-smelling essential oil which remains in a state of solution in the oil itself and cannot be easily separated on distillation.

In a recent paper by Sen and Banerjee (1931), it has been shown that the bitterness of the oil is due to the presence of the sodium salt of an acid and partly to the presence of the free acid which are held in solution in the oil. The acid contains sulphur in its molecule and is unsaturated.

Pharmacology of Margosates :—The pharmacological action of the margosates was studied by Chatterjee and Roy. They have a powerful action against protozoa, a solution of 1 in 10,000 killing the flagellate Prowazekia in 5 minutes. The results obtained by these workers are as follows :

Drug used	Dilution which suffices to kill in 5 minutes
Quinine sulphate	... 1 in 100,000
Emetine	... 1 in 10,000
Tartar emetic	... 1 in 500
Sodium margosate (B.C.P.W.) ...	... 1 in 10,000

Paramœcium caudatum was killed instantaneously with 1 in 2,000 solution. The sodium salt of the acid was also tested on microfilariæ and it killed these organisms in 35 seconds in a concentration of 1 in 200. These workers considered that, along with their strong parasitotropic properties, the margosates possess very low organotropic properties. The carbolic acid co-efficient of the soluble salts is only 2 and, therefore, the anti-bacterial or bactericidal properties of margosates are not very marked *in vitro*. They, however, consider that there is sufficient clinical evidence to show that margosates have a powerful action against bacteria in the body.

Therapeutic Uses :—*M. azadirachta* is a reputed remedy for skin affections and in view of the parastiotropic properties of the margosates, it was tried on a number of cases of scabies, eczema, pemphigus, etc. The results obtained were promising in some patients but not so satisfactory with others ; on the whole the drug was considered to have a beneficial effect. The possibility of its possessing anti-spirochætal properties led Chatterjee to try margosate in the treatment of syphilis. Sodium margosate was given in solution, in doses varying from 0.01 gm. to 0.325 gm. subcutaneously, intramuscularly and intravenously in the primary, secondary and tertiary stages of syphilis. In the primary and secondary stages, the initial lesion and secondary manifestations disappeared under its influence much more readily than in untreated cases. In the late secondary and tertiary stages the skin lesions, gummata, etc., soon subsided. The results, however, were not so satisfactory as those obtained from administration of the arsenicals, mercurials, bismuth and iodides.

The juice of margosa leaves has a reputation in indigenous medicine as an anthelmintic. In order to confirm the truth of this statement, Caius and Mhaskar (1923) administered it in one dose of 4 drachms preceded and followed by purgation. Neem oil was also tried in doses of 1 to 4 drachms. The maximum dose of the oil produced occasional diarrhœa, nausea and general discomfort but both the leaves and the oil proved quite ineffective in expelling the intestinal parasites.

References :—

(1) Chatterjee and Roy, 1917, *Ind. Jour. Med. Res.*, Vol. V, p. 656; (2) Watson, Chatterjee and Mukerjee, 1923, *Jour. Soc. Chem. Ind.*, Vol. I, p. 387; (3) Caius and Mhaskar, 1923, *Ind. Jour. Med. Res.*, Vol. XI, p. 364; (4) Dutt, R. L., and others, 1930, *Industries Dept. Bull.*, No. 47; (5) Sen, R. N., and Banerjee, G., 1931, *Jour. Ind. Chem. Soc.*, Vol. VIII, p. 773,

MORINGA PTERYGOSPERMA (N.O. Moringeæ)

VERN.—Sans.—*Sobhanjana* ; Hind.—*Shajnah, Shajna, Segva* ; Beng.—*Sojna* ; Uriya.—*Munigha, Sajina* ; U.P.—*Sahajna* ; Punj.—*Sanjna* ; Bomb.—*Sujna, Sanga* ; Burm.—*Dandalonbin* ; Sing.—*Murunga*.

The medicinal virtues of this plant have long been known and appreciated in India. It has been frequently mentioned by Chakradatta, also in the 'Bhavaprakasa', and in other Sanskrit works on medicine. Almost all the parts of the plant, *e.g.*, roots, leaves, seeds, flowers, etc., have been used sometime or other in the treatment of various ailments in the indigenous system. The seeds are called 'sweta maricha' or white pepper and have been described as acrid and pungent. They are also said to be stimulant and are given in cases of ascites resulting from enlargement of the liver and spleen.

The oil expressed from the seeds is used externally for relieving pain of the joints in gout and acute rheumatism. A decoction of root bark is recommended for internal administration by Chakradatta, and in the 'Bhavaprakasa' for ascites, enlarged spleen or liver and calculus affections. It is also directed to be used externally as a poultice, plaster or decoction over inflamed parts and is supposed to reduce these swellings. The fresh juice of the root bark is recommended for the same diseases as a decoction, and is also said to relieve otalgia when poured into the ears.

The root of the young tree is still prescribed by the indigenous practitioners in small doses in a variety of conditions like intermittent fever, epilepsy, hysteria, palsy, chronic rheumatism, dropsy, enlargement of the spleen and dyspepsia. Sometimes the fresh root is mixed with mustard seeds and green ginger for external use as a counter-irritant and blistering agent. The root has also been recommended by Hakims in the treatment of soreness of the mouth and throat and pain in the gum due to dental caries. It has been used as an abortifacient, a rubefacient and counter-irritant in rheumatic cases and enlargement of the liver in children. The root in the form of a compound spirit has been successfully used

in fainting, giddiness, nervous debility, spasmodic affections of the bowels, hysteria and flatulence. The gum has been used in the Punjab in rheumatism and as an astringent. The Hakims administer the fruit in affections of the liver and spleen, articular pains, tetanus, debility of nerves, paralysis, pustules, patches, leprosy, etc.

The young leaves are used as food. They have been used with other ingredients in the treatment of dog-bite and scurvy. They have also been used in catarrhal affections. The pods have been used as a vegetable for edible purposes and are supposed to act as a preventive against intestinal worms.

The flowers are commonly used as food. These are sometimes boiled with milk and the preparation is used as an aphrodisiac. Mohammedan writers describe the flowers as hot and dry, and consider them useful in cold humours and swellings. They are supposed to be tonic and diuretic and to increase the flow of bile. The juice has been prescribed with milk as a diuretic, antilithic and digestive, and is useful in asthma.

The *Moringa pterygosperma* tree is fairly large and pretty and grows wild in the Sub-Himalayan tract from the Chenab to Oudh. It is commonly cultivated in India and Burma. The leaves, flowers and fruits are all eaten as vegetables. The tree produces flowers and fruits in abundance twice or at times thrice a year. The corky, grey bark is about an inch thick and has longitudinal cracks. It yields a coarse fibre which is utilised in preparing mats, paper or cordage. The roots are pungent and have the taste of horse-raddish. The wood of the root is soft, porous and yellowish, and has the same properties but in a less degree. The bark of the root is thick, soft and reticulated; it is light brown externally, soft and white internally. The gum is opaque and white when it first exudes but on exposure to air soon changes to pink, dull red or mahogany colour on the surface. The samples vary in shape from stalactite pieces to tears and appear to be only produced upon the trees which have been injured by insects. The taste is bland and mucilaginous. The gum becomes very friable in dry air and is tough in a damp climate. It holds 20 per cent. of its weight of water. The gum belongs to the tragacanth or hog gum series, but on account of its dark colour, it has not much value in European commerce. It is insoluble in water. The seeds yield on simple pressure a clear, limpid, almost colourless oil, rather thick at ordinary temperature. This oil has a specific gravity of 0.912 to 0.915 at 60°F, and is almost devoid of

odour and flavour, saponifies slowly and does not turn rancid. It is one of the best lubricants for fine machinery and is highly valued by watch-makers. The oil from this species, and that from *M. aptera*, Fuss., are commercially known as Ben oil. It is a remarkable fact that, though the tree is cultivated to a great extent in India, the oil is seldom extracted here and so it does not form an article of export. India might easily and apparently profitably supply the whole world with Ben or Moringa oil, and one can reasonably hope that attention may be directed to the subject. It is also highly esteemed by perfumers, for its great power of absorbing and retaining even the most fugitive odours.

Chemical Composition:—A preliminary extraction with solvents gave the following extractives:—petroleum ether 0.71 per cent., sulphuric ether 6.47 per cent., chloroform 0.68 per cent., and absolute alcohol 2.17 per cent. The alcoholic extract gave strong reactions for alkaloids. An assay of the bark showed the presence of 0.105 per cent. of total vegetable bases. For isolation of the bases the bark was extracted by cold percolation with rectified spirit, the alcohol distilled off and finally concentrated *in vacuo*. The residue was extracted with dilute acid, filtered, the extract made alkaline and extracted with ether and finally with chloroform. The residue from the solvents was dissolved in alcohol, neutralised with HCl and evaporated. The dry residue was extracted with hot chloroform. The insoluble portion was repeatedly recrystallised from alcohol and the hydrochloride was obtained in colourless glistening plates, M.P. 254.2°. The platinic chloride crystallised in yellow rectangular plates with M.P. 221°, the picrate crystallised in yellow wooly needles M.P. 195°. The free base remained liquid at room temperature and could not be crystallised. The hydrochloride of the second base, soluble in hot chloroform, has not been obtained crystalline, but it had a strong physiological action.

Pharmacological Action and Therapeutic Uses:—The pharmacological action of the vegetable bases isolated from *Moringa pterygosperma* has been worked out by Chopra and De (1932, unpublished). The crystalline base has little or no physiological action, whereas the amorphous base shows a marked activity, and closely resembles adrenaline and ephedrine in its effects. This base thus belongs to the sympathomimetic group of bases. It acts on the sympathetic nerve endings all over the body producing a rise of blood pressure, acceleration of heart-beat and constriction of the blood vessels. Its effect on the heart is mainly through the sympathetic though the myocardium may also be slightly stimulated. It also inhibits the tone and movements of the involuntary muscle of the

gastro-intestinal tract and the bronchioles. The effects of sympathetic stimulation were also found in the action of this base on other organs. It produces slight diuresis on intravenous injection in animals, dilates pupils and is detoxicated by the liver. Very large doses depress the vasomotor nerve-endings. This base differs from adrenaline in that it produces little or no rise of blood pressure after ergotoxine whereas adrenaline produces a fall under similar conditions. The sympathomimetic base isolated from *M. pterygosperma* is, however, very much weaker in its action than adrenaline or ephedrine.

The amount of bases present in the alkaloid are very small and its practical utility in therapeutics is doubtful unless the quantity of active principles is increased by suitable cultivation.

References :—

(1) Chopra, R. N., and De, P., 1932, *Ind. Med. Gaz.*, Vol. LXVII, p. 128; (2) Chopra, R. N., and others, 1932, unpublished.

PEGANUM HARMALA (N.O. Rutaceæ)

Syrian Rue

VERN.—Hind.—*Hurmal, Harmal* ; Beng.—*Isband* ; Bomb.—*Hurmal* ; Tam.—*Shimai-azha-vanai-virai* ; Tel.—*Sima-goronti-vittulu* ; Pers.—*Isband*.

This is a bushy herb one to three feet in height, growing wild all over North-Western India, Sind, the Punjab, Kashmir, Agra and the Western Deccan. It is also distributed to Arabia, North Africa, Hungary and Spain. Large quantities of the seeds are imported into India from Persia, and they yield a red dye. The drug, as found in the bazar, consists of the seeds mixed with capsules. In the indigenous medicine 'harmal' is described as alterative, purifying, aphrodisiac and lactogogue. There is reference to show that the seeds were used by the ancient Greeks as they are to this day in India. The powdered seeds were used as anthelmintics against tapeworms.

Chemical Composition :—The seeds contain three alkaloids—*harmine, harmaline* and *harmalol*, to the extent of 4 per cent.; harmaline occurs in largest amounts, being ⅔ the quantity of the total alkaloids; harmalol occurs only in traces. The alkaloids were extracted by percolating the finely ground seeds with very dilute sulphuric acid, adding salt to the liquors to precipitate the mixed alkaloidal hydrochlorides which after washing with brine are dissolved in water. When the solution is decolourised with animal charcoal, warmed to 50° and fractionally precipitated with ammonia, harmine comes out; harmaline may then be isolated by adding a considerable excess of ammonia.

Pharmacological Action :—Flury (1910) investigated the anthelmintic properties of the alkaloids occurring in the seeds of *Peganum harmala*. Harmaline was found to have some anthelmintic action probably by paralysing the musculature of the parasites. Both harmine and harmaline paralysed the skeletal and cardiac muscles of frogs. In warm-blooded animals, harmine and harmaline caused convulsions, salivation, interference with respiration and depression of temperature. Harmaline stimulated the respiration in small doses but in large doses paralysed it. The minimal toxic dose of harmaline for rabbits was determined to be 0.23 gm. per kilogram of body weight. According to Gunn (1910, 1912), harmaline resembles quinine in having more toxic effects on mammals than on frogs. Harmine produces a fall in blood pressure in mammals due to weakening of the contractions of the heart. Death occurs as a result of cardiac failure in these cases. Gunn and Marshall (1920) have concluded that harmaline belongs to the group of protoplasmic poisons of which the best known alkaloid is quinine and that the actions of harmaline and quinamine are practically identical.

Therapeutic Uses :—*Peganum harmala* seeds have been used as a remedy for tapeworm in man and in the treatment of intermittent and remittent fevers. Gunn and Marshall state that the drug is useful in chronic malaria but is not so effective in acute cases. Harmine by itself was also found to be remarkably efficient in certain relapsing cases. Harmaline was tried in patients suffering from both acute and chronic types of malaria in the Carmichael Hospital for Tropical Diseases, but

did not produce any appreciable effect either on the malarial parasites or on the clinical symptoms of the disease.

References :—

(1) Henry, 1924, *The Plant Alkaloids*, Second Edition; (2) Gunn, J. A., 1910, *Trans. Roy. Soc. Edin.*, Vol. 47, p. 245; (3) Gunn, J. A., 1912, *Trans. Roy. Soc. Edin.*, Vol. 48, p. 83; (4) Gunn and Marshall, 1920, *Proc. Roy. Soc. Edin.*, Vol. 40, p. 140.

PIPER BETLE (N.O. Piperaceæ)

Betel Leaf

VERN.—Sans.—*Tambula, Nagavalli* ; Hind., Beng. & Guj.—*Pan* ; Mar.—*Videcha-pana* ; Tam.—*Vettilai* ; Tel.—*Tamalapaku* ; Arab.—*Tanbol* ; Pers.—*Barge-tanbol, Tambol.*

It is a perennial diœcious creeper, probably a native of Java, cultivated for the sake of its leaves, in the hotter and damper regions of India and Ceylon. The plant is very widely distributed under cultivation in the United Provinces, Bengal, Central Provinces and Madras and a number of different varieties are grown. A detailed description of these is to be found in Watt's 'Dictionary of the Economic Products of India'.

Ancient Hindu writers recommend that betel leaf should be taken early in the morning, after meals, and at bed-time. According to 'Susruta', it is aromatic, carminative, stimulant, and astringent. It sweetens the breath, improves the voice and removes all foulness from the mouth. According to other writers it acts as an aphrodisiac. Medicinally, it is said to be useful in diseases supposed to be caused by deranged phlegm and its juice is much used as an adjunct to pills administered in these diseases. In the Konkan the fruit is employed with honey as a remedy for cough, and in Orissa the root is said to be used to prevent child-bearing. The plant was included in the secondary list of the Indian Pharmacopœia, but nothing was said about its therapeutic use. No European physician in

People chewing betel for the first time, however, seem to experience very characteristic cerebral effects. Uneasiness, a stifling sensation, especially faintness, slight excitation, outbreak of sweat and occasionally torpor are the symptoms likely to occur. They are not of long duration and after habituation is established do not occur again. The habit appears to be harmless and even excessive users do not suffer from any toxicological effects. Taken as a whole the evil consequences of betel chewing are relatively trifling.

The habit of chewing betel leaf is common among races whose chief articles of dietary consist of carbohydrates such as rice, etc. Large quantities of saliva produced by chewing betel leaf act as digestive and probably the presence of diastase enhances this activity. The gastric juice in these people takes a minor part in the digestion of food. When deprived of betel leaf or other sialagogues they suffer from severe indigestion.

References :—

(1) Chopra, R. N., and Chandler, A. C., 1928, *Anthelmintics and their Uses in Medical and Veterinary Practice;* (2) Lewin, L., 1931, *Phantastica;* (3) Kemp., D. S., *Pharm. Jour*, 1890, Vol. 20, p. 749; (4) Wehmer, 1929, *Die Pflanzenstoffe;* (5) Gildemeister and Hoffmann, 1913, *Die Ätherischen Öle.*

PISTACIA INTEGERRIMA (N.O. Anacardiaceæ)

VERN.—Sans.—*Karkata sringi* ; Hind.—*Kakra-singi* ; Beng.—*Kakra-sringi* ; Punj.—*Sumak* ; Tam.—*Kakkatashingi.*

It is a tall tree commonly met with in the Sub-Alpine Himalayas. On the leaves and petioles of this plant are found peculiar gall-like excrescences, which give the appearance of 'horns' from a distance. These 'galls' are formed by a kind of insect (aphis). The galls vary in size ; the external surface is of a pale greenish brown colour and has a fimbriated appearance. On breaking open the galls, a reddish inner surface is seen and appears to be covered with particles of dust which, on microscopical examination, is found to be the

debris of the insects and their excrementitious matter. The taste of the powdered galls is very astringent and slightly bitter and they have a terebinthine odour. They have long held a place in the Hindu Materia Medica as a useful remedy in cough, phthisis, asthma, etc. The usual dose is 20 grains combined with demulcents and aromatics. The Mohammedan writers consider it useful in pulmonary affections and in diarrhœa and vomiting. European writers also mention the drug but say nothing about its properties.

Chemical Composition :—Little work has previously been done on the chemistry of this drug. A chemical examination indicates chiefly the presence of the following substances :—Essential oil 1.21 per cent., crystalline hydrocarbon 3.4 per cent., tannin substances 60.0 per cent., and gum mastic 5.0 per cent.

The essential oil was obtained by steam distillation of the coarsely powdered drug. The essential oil is of a pale greenish yellow colour with a turpentine-like odour and taste. The specific gravity of the oil is 0.8885 at 15°C. A crystalline principle was obtained by treating the alcoholic extract with light petroleum ether, distilling off the ether and treating the residue with absolute alcohol. This on concentration deposited large transparent prismatic crystals. The substance is insoluble in water, soluble in nearly all the organic solvents, is tasteless and has a sharp melting point of 146°C.

The tannins present are of a yellowish crystalline appearance and can be obtained from an aqueous solution of the drug by precipitating with lead acetate, and decomposing the precipitate in suspension in water with sulphuretted hydrogen, concentrating and drying. An estimation of the tannins showed their amount to be nearly 60 per cent. in an air-dried sample of the drug.

After removing the essential oil and the crystalline hydrocarbon by means of petroleum ether from an alcoholic extract of the drug, dissolving the residue in alcohol and pouring it in cold water, the insoluble resin can be precipitated, while the tannins remain in the solution. By repeating the above process the resin can be obtained in a fairly pure condition. Its chemical behaviour is identical with that of gum mastic. No substance of the nature of an alkaloid or glucoside could be detected.

The drug has a great reputation both in the Hindu and the Mohammedan medicine as a tonic and expectorant, and it is useful in asthma, phthisis and other conditions of the respiratory tract. Its use in pulmonary affections is no doubt due to the presence of a fair amount of essential oil, while the

large amount of tannins present in the drug acts as a strong astringent. On the whole we found that the importance of the drug was very much overrated. It may be classed with the terebinthinate astringents. This drug appears to have no advantage over many of the stronger expectorants in the British Pharmacopœia and its antiseptic action is not of higher order.

References :—

(1) Chopra and Ghosh, 1929, *Ind. Jour. Med. Res.*, Vol. XVII, p. 377.

PLANTAGO OVATA (N.O. Plantagineæ)

Ispaghula ; Spogel Seeds.

VERN.—Hind.—*Isabghul, Ispaghul, Issufgul* ; Beng.—*Isabgul* ; Bomb.—*Isapghol* ; Tam.—*Ishappukol-virai* ; Pers.—*Ispaghol, Isparzah, Shikam-daridah* ; Arab.—*Bazre-quatuna, Bazre-katima.*

The genus Plantago comprises about 50 species, of which ten are natives of India. A number of these herbs have been used in the indigenous medicine for many centuries. This herb is found growing in the plains of the Punjab and Sind and low hills from the Sutlej westward ; it is also cultivated to a small extent in different parts of India, such as Bengal, Mysore and the Coromandel coast. Westward it is also distributed to Spain and the Canaries.

The seeds of this plant are boat-shaped, about 1/8 inch long and rather less than 1/16 inch broad. They are translucent and pinkish grey but the colour may vary, some being brown, while others are white with a pinkish tinge, the latter being generally preferred. The concave side of the seeds is covered with a thin white membrane. When microscopically examined the epidermis of the seeds is found to be composed of polyhedral cells, the walls of which are thickened by secondary deposit, which are the source of the mucilage. Between it and the albumin is a thin brownish layer; the albumin is formed of thick-walled cells which contain granular matter. When soaked in water the seeds become enormously swollen with an abundant coating of adhering mucilage which is free from taste and odour.

The seeds of several other species of the same genus exhibit similar properties. *P. amplexicaulis* is a plant which grows in the plains of the Punjab, Malwa and Sind, extending to Southern Europe. It furnishes the brown Ispaghula which is not infrequently met with in the Indian bazars. These seeds have also a boat-shaped appearance like those of *P. ovata* but are rather large, averaging 1/6 inch in length. They produce mucilage in the same way and probably have just as effective demulcent properties as the true *P. ovata* seeds. Large quantities of these seeds are imported into India from Persia.

P. major known as 'luhuriya' in Hindi and 'bartang' or 'barhang' in Persian, is a large herb which is found on the Alpine Himalayas from Peshawar and Kashmir to Bhutan at a height of 2,000 to 8,000 feet above the sea level, as well as in Western Tibet at an altitude of 10,000 to 12,000 feet. It has also been reported to grow in Assam, Khasia Hills, Burma, Malacca, Singapore, Bombay, the Nilgiri Hills and the higher parts of Sudan. This plant was used in the ancient Roman and Grecian medicine. The seeds of *P. major* are imported largely into India from Persia and have the same properties as those of *P. ovata*. They are at the present time largely used in the indigenous medicine in India as a remedy for dysentery.

The seeds are oblong and brown, marked with waves having slightly elevated longitudinal ridges of a dark colour. One side of the seed is arched and the other side is concave and marked with a scar showing the attachment to the ovary. They are insipid and have an oily taste when crushed. When soaked in water they become coated with a thick layer of transparent mucilage resembling *P. ovata*.

Some of the other species of Plantago are *P. psyllium* (which is practically the same as *P. mojor*), *P. brachyphylla* and *P. lanceolata*.

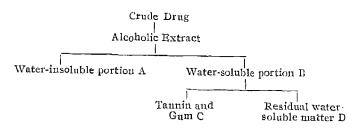
Uses in the Indigenous Medicine :—*P. ovata* seeds are not mentioned by the writers of the Hindu medicine and appear to have been unknown to them. They, along with the seeds of several other species of Plantago, were very frequently referred to by Arabian and Persian writers who esteemed them very greatly as medicinal agents. Even as far back as the 10th century the Persian physician Albervi mentioned them and a little later Avicenna referred to this drug. All the subsequent writers on Mohammedan medicine have extolled the properties of 'ispaghula'. The seeds were introduced in the Indian medicine by the advent of the Mohammedans and they began to be largely used as a popular remedy in chronic dysentery and intestinal fluxes. Even at the present time they are perhaps the most extensively used remedies for intestinal conditions. For any kind of diarrhœa, especially when blood or mucus is present in stools, it is a popular household remedy. The seeds are also considered to be cooling and demulcent and besides diarrhœa, dysentery and other inflammatory and functional derangements of the digestive organs they are also

recommended in febrile conditions. They are said to have diuretic properties and are given in affections of the kidneys, bladder and urethra (gonorrhœa) in doses of 2 to 3 drachms either mixed with sugar or in the form of a decoction. Powdered seeds are frequently mixed with seeds of *H. antidysenterica* and are given in dysentery. The crushed seeds are made into a poultice and are applied to rheumatic and glandular swellings. A cooling lotion for the head is also prepared from the mucilage; and a decoction of the seeds is prescribed in coughs and colds. A slight degree of astringency is believed to be imparted to the seeds by heating them in the dry condition.

P. ovata seeds are frequently mixed with seeds of *Salvia ægyptiaca* (Vern. *Tukhm malanga*), which also grows in the plains of the Punjab and like *P. ovata* seeds yield copious mucilage.

Chemical Composition :—The seeds contain a fatty oil, albuminous matter and mucilage in such large quantities that 1 part of the seeds with 20 parts of water forms a tasteless jelly within a short time. On addition of a large quantity of water and filtering, little mucilage passes, but the major part of it remains adherent to the seeds. The mucilage can be separated by straining with pressure. It is neutral in reaction, is not altered by adding or precipatated by boiling with alcohol nor is it changed by iodine, borax or perchloride of iron. It is only sparingly soluble in water. A glucoside named *aucubin* $C_{13}H_{19}O_8 . H_2O$ has been isolated from the seeds, leaves, roots and flowering stems of *P. major* and *P. media* and also from the leaves, roots and seeds of *P. lanceolata*. It crystallises in the form of colourless bush-forming needles which have a melting point of 181°C and a rotation in aqueous solution of −164.9°. This glucoside has also been found in *Ocuba japonica* and probably occurs in some of the other plants belonging to the natural order Plantaginaceæ.

Henry and Brown (1924) examined a number of reputed remedies used against amœbic dysentery. *Mansonia ovata* and *Rhyncosia adenodes* are used in South Africa; *Brucea abyssinica* and *B. sumatrana* are used in Abyssinia and Malay respectively. These four drugs were examined chemically without showing any active constituents to which their amœbicidal action could be attributed. From *M. ovata* a substance called 'entericin' was isolated, but this is an ill-defined substance. From the two species of brucea amorphous bitter substances were isolated, but trials on the free-living protozoa showed them to be quite inactive either alone or in presence of alkali. *R. adenodes* showed no active substance. These investigators tried to combine the biological and chemical methods in the hope of being able to select some from the large number of such available drugs which seemed promising enough for detailed examination. The finely-ground drug was exhausted with boiling alcohol, the extract concentrated *in vacuo* and the thick syrup diluted with water to precipitate fatty and resinous matters, which formed preparation A. The liquor

from this precipitate, after further concentration *in vacuo* to remove all the alcohol, constituted preparation B. The latter was then treated with lead acetate to remove tannin and gum, which after recovery from the lead precipitate, gave preparation C; and the residual liquor, after removing the excess of lead, yielded preparation D.

All these four fractions were carefully examined and their action tested on protozoa. None of them possesses any great degree of toxicity to these organisms.

Pharmacological Action :—The author (1930) confirmed the presence of a body of the nature of a glucoside in small quantities in the seeds of *P. ovata* ; this was pharmacologically inactive and was very difficult to obtain in a pure condition. No other physiologically active substance was found ; the tannins which are present in appreciable quantities have very little action on the protozoa or bacteria. The efficiency of the drug would appear to be entirely due to large quantities of the mucilage. This gelatinous substance was, therefore, carefully examined.

It has a jelly-like consistency and is acted on by the digestive enzymes to a very slight extent, especially when it is on the seeds. Even after incubation for 24 hours with salivary enzymes, pepsin and hydrochloric acid and the pancreatic enzymes there was very little digestion of the mucilage. It thus passes through the small intestine unchanged and during its passage it lines the mucous membrane acting as a demulcent and a lubricant. Further, the mucilage is not acted on by the intestinal bacteria in the large gut. Its presence there in fact would appear to have an inhibitory action on the growth of the organisms.

The action of such organisms as *B. shiga*, *B. flexner*, *B. cholera*, *B. coli* and bacteria from whole stool, was tested on the mucilage by putting it in broth cultures in which these organisms were grown. The tubes were put in an incubator and even after a fortnight still remained unaffected. That the mucilage does not form a good media for the growth of intestinal organism is shown by the fact that if it is allowed to set in a petri dish and the surface is plated with the culture of such organisms as *B. shiga*, *B. flexner*, *B. coli* and other fœcal organisms, no colonies are found to grow. It has also been shown that if a thin layer of the mucilage is spread on the surface of agar media inoculated with *B. shiga*, *B. flexner*, etc., the growth of these organisms is greatly inhibited.

That the mucilage is not acted on to any great extent by the digestive enzymes in the small intestine or the bacteria in the large intestine is further shown by the fact that large quantities of it can be seen in the stool after administration of the seeds. The author gave a dessert spoonful of the powdered seeds to cats with a stomach tube. On opening up the intestine on the following day, the whole of the mucilage was found spread on the surface of the mucous membrane of the small and the large intestines. In the latter where the contents had assumed a solid form, both the mucilage and seeds were on the surface of the mucous membrane forming a layer between the solid fæces and the surface of the mucosa. From these experiments it is clear that the mucilage forms a coating over the surface of the ulcers. This would not only protect the injured mucosa from the irritating products of gastro-intestinal digestion but would also prevent access of the motile bacteria which would be entangled in the meshes of the gel.

The mucilage further being of colloidal nature has a remarkable power of absorbing bacterial and other toxins. Our experiments *in vitro* have shown the jelly-like mucilage from *P. ovata* seeds is very active in this respect.

Therapeutic Uses:—The seeds were noticed early by the Western practitioners and eventually found their way into the Indian Pharmacopœia in 1868. In the early part of the 18th century, Fleming, Ainslie and Roxburgh all spoke favour-

ably regarding their value in diarrhœic conditions. Since then they have been very extensively tried by many Western practitioners who have confirmed the opinion that they are useful in chronic dysentery and diarrhœa. Some clinicians have combined the seeds with ipecacuanha treatment. They are said to be very useful in all inflammatory affections of the mucous membrane of the alimentary canal on account of their emollient, demulcent and laxative properties.

For the past 15 years the present writer has given very extensive trials to the seeds of *P. ovata* in the following conditions with excellent results.

(1) *Chronic Bacillary Dysentery.*—This condition is invariably associated with the presence of mucus in the stools. According to Acton and Knowles (1928), the commonest type of chronic bacillary dysentery in India is due to infection with Flexner's bacillus, next comes Strong's bacillus and lastly Shiga's bacillus. Some of the chronic diarrhœas in the tropics are due to Morgan's bacillus or the para-dysentery group. The bowel in these conditions is generally ulcerated and the toxins absorbed from the ulcerated surface produce a diminution of tone of involuntary muscle of the gut wall producing intestinal stasis, visceroptosis and a general toxæmic condition in the individual. Chronic diarrhœa with painful peristalsis persists for prolonged periods and may alternate with periods of constipation. The condition is intractable and may persist for years.

(2) *Chronic Amœbic Dysentery.*—These patients may have constipation or irregularity of bowels and the large majority show mucus in their stools. The degree of ulceration varies much according to the intensity of the intestinal symptoms. There are two types of these patients—the lean, thin, neurasthenic type who suffer from habitual constipation or constipation alternating with diarrhœa, or the fat, jovial type who suffer from chronic morning diarrhœa.

(3) *Chronic Constipation with Auto-intoxication Produced from other Causes.*—In the first two conditions the administration of the seeds gives a considerable relief to the patient. It has already been stated that the seeds do not contain any active principles having any marked toxic effect on the bacteria or

protozoa. There are small quantities of tannins present, but their effect in this respect is very slight indeed. The whole action of the drug appears to be entirely mechanical. The irritated or ulcerated surface of the intestinal mucosa are soothed by the demulcent action of the mucilage which covers the surface and in this way prevents it from coming in contact with irritating products of digestion of food stuffs, intestinal juices and gases which are always present in the intestine and which irritate the parts and prevent the ulcers from healing. Exclusion of these factors enables the ulcers to heal and inflammation of the mucosa subsides. Further, the absorption of toxins, which takes place rapidly from the ulcerated surface, is prevented by a coating of the mucilage which being of a colloidal nature, adsorbs the toxins from the gut and thus helps in excreting them from the body. As the jelly-like mass is not quickly acted on by the gastro-intestinal juices and bacteria practically the whole of it is available, and passes out in the stool carrying with it the adsorbed toxins in the course of the next 12 hours. In this way the patient not only gets relief of the pain, tenderness or discomfort in the abdomen but his general condition is also improved owing to decrease in the absorption of toxins. In chronic amœbic dysentery which has failed to react to intensive courses of emetine or the kurchi alkaloid, the author has tried prolonged courses of liquid extract of kurchi (*H. antidysenterica*) and ispaghula with success. The patient is put on 2 drachms of the extract, 3 or 4 times a day, at the same time he takes 2 or 3 heaped dessert-spoonfuls of the seeds twice daily, the treatment being continued for six weeks or two months. Not only is there considerable relief to the symptoms but examination of the stools shows disappearance of *E. histolytica*.

In chronic amœbic dysentery where constipation is one of the main symptoms, the mucilage covers the fæces as they become solid in the large intestine and thus facilitates their passage through the large gut by acting as a lubricant. In this condition as well as in chronic spastic constipation its action may be aided by giving small doses of saline purgatives.

(4) *Hill Diarrhœa.*—This condition is not infrequently met with in people who go up to the hills and is more common among Europeans. The patient usually passes several stools in the morning and the condition is accompanied by catarrh of intestine. *P. ovata* seeds are particularly useful in the early stages. Not only is the irritated mucous membrane soothed and protected by the mucilage, but the fermentation is also inhibited and the stools assume a solid form.

(5) *Chronic Diarrhœa in Children* is also considerably benefited. Most of these conditions are due to irritation of the gut with bacterial toxins and the mucilage acts by removing this irritation.

Dosage and Modes of Administration of P. ovata Seeds:—The seeds are thoroughly cleaned from sand and grit and other extraneous matter with which they are always found mixed in commerce. This can be done by sifting them through a fine sieve or mosquito-netting and picking out anything which still remains with the fingers. Before the seeds are taken they should be quickly washed once or twice in a cupful of water. The usual dose recommended is 2 to 4 drachms, but considerably larger quantities, *i.e.*, 1 to 2 ounces, may be given with advantage. Two to three heaped dessert-spoonfuls of the seeds or more if necessary may be given 2 or 3 times a day. They contain no toxic principles of any kind and most of them pass out of the gastro-intestinal tract in 6 to 12 hours. In fact in some cases, especially when constipation is present, larger doses are essential as their action is produced partly by the lubricating action of the mucilage and partly by the increase in the bulk of the intestinal contents which mechanically stimulates the intestinal peristalsis. Four methods are recommended for the administration of the seeds:—

(1) The clean, dry seeds are put in a cupful of water and after a preliminary washing, 1 or 2 teaspoonfuls of sugar is added if desired. The mixture is stirred and taken.

(2) The seeds are added to a cupful of water and are allowed to stand for 20 to 30 minutes till all the mucilage comes out. If desired some sugar is added and the mucilaginous mass is then swallowed.

(3) A mucilaginous decoction is prepared by boiling the required quantity of the seeds in a couple of pints of water till the quantity

is reduced to about half. This is then taken divided into doses of 2 to 4 ounces and taken every 2 or 3 hours. It has already been pointed out that the mucilage is not altered by boiling.

(4) The mucilage-containing cover of the seeds is separated from the seeds by crushing them and separating the husk by winnowing. One to two teaspoonfuls of it are given in a cupful of water with a little sugar. By many indigenous practitioners this preparation is preferred to whole seeds, especially in acute conditions of the gastro-intestinal tract.

The author prefers the first method in ordinary chronic forms of dysentery and diarrhœa as it allows the seeds to mix thoroughly with the intestinal contents and in this way enables them to spread over the whole of the surface of the mucous membrane evenly. If the mucilage is allowed to form outside it conglomerates into sticky masses and is not evenly distributed and passes out of the intestine in lumps. It has been shown by experiments *in vitro* that the digestive enzymes have a weaker action on the mucilage when it is on the seeds. When a decoction is made and the mucilage is separated, it is partly changed by the digestive enzymes into a non-mucilaginous substance after incubation for 24 hours, whereas that on the seeds is little altered. This supports the superior action of the whole seeds. The decoction and mucilage-containing cover separated from the seeds is, however, preferable in sub-acute types of dysenteries both of protozoal and bacillary origin. The drug has the advantage of being tasteless, in fact with sugar it is quite pleasant to take. It is therefore not objectionable to take and is very suitable for children.

Various preparations of paraffin are being used as intestinal lubricants. They enter the cæcum mixed with the iliac contents and keep the contents of the large gut soft. In addition they accelerate the passage of fæces through the large intestine which consequently does not become overloaded. Paraffin being a mineral product is not absorbed and practically the whole of it can be recovered from the stools. A perusal of what has been said about the mucilage of *P. ovata* seeds will show that it acts in very much the same way as liquid paraffin does so far as its lubricant and constipation-relieving effects are concerned. It is further free from many disadvantages

which liquid paraffin possesses. It is well-known that even the best preparations of paraffin are not free from producing irritant effects and many cases of malignant disease of the large gut have been attributed to its long-continued use. Eczema ani does not uncommonly occur in persons habituated to its use and 'paraffin pains' are not of very rare occurrence. It has also been stated that long-continued use of liquid paraffin may prevent absorption of nutrient material from the intestines by forming a thin impermeable coating round the intestinal villi and cases of malnutrition have been recorded after its prolonged use. *P. ovata* mucilage is a vegetable product and is free from all these disadvantages, besides being very much cheaper. Two or three dessert-spoonfuls taken at bed time produce the same laxative effects as liquid paraffin.

Summary :—The seeds of *P. ovata* are very beneficial in chronic dysenteries of amœbic and bacillary origin and chronic diarrhœas due to irritative conditions of the gastro-intestinal tract. A glucoside named *aucubin* has been found in the seeds but it is physiologically inactive. The tannins which are present in appreciable quantities have little action on the entamœbae or bacteria. The action of the drug would appear to be purely mechanical, being due to the large amount of mucilage which is contained in the superficial layers of the seeds. This mucilage is shown not to be acted on by the digestive enzymes passes through the small intestine unchanged. It lines the mucous membrane of this part of the gut and its demulcent properties give it a protective and sedative action. In the large gut the intestinal bacteria have been shown to have little or no action on the mucilage. Practically the whole of it is passed out unchanged during the 12 to 24 hours following its administration. During its passage through the gut it coats the inflammed and ulcerated mucosa and protects it from being irritated by the fluids and gases, the products of gastro-intestinal and bacterial digestion. This enables the lesions to heal quickly. The toxins present in the gut are further absorbed by the gel and their absorption into the system is prevented. The seeds are taken in large quantities and as they swell up in contact with water they increase the bulk of the

intestinal contents and in this way relieve chronic constipation by mechanically stimulating the intestinal peristalsis. The mucilage of *P. ovata* seeds acts in very much the same way as liquid paraffin. It is very much cheaper and is further free from the injurious effects produced by the habitual use of the latter drug, *i.e.*, malignant disease of the colon, eczema ani, paraffin pains, etc.

References :—

(1) Henry and Brown, 1924, *Trans. Roy. Soc. of Trop. Med. and Hyg.*, Vol. XVII, p. 378; (2) Acton and Knowles, 1928, *The Dysenteries of India;* (3) Chopra, R. N., 1930, *Ind. Med. Gaz.*, Vol. LXV, p. 428.

PLUMBAGO ROSEA (N.O. Plumbagineæ)

VERN.—Sans.—*Raktachitraka, Chitraka, Rakta-shikha* ; Hind.—*Lal-chitarak, Chitra, Lal-chitra* ; Beng.—*Lal-chita, Rakto-chitra* ; Uriya.—*Lal-chita* ; Bomb.—*Lal-chitra* ; Tam.—*Chittur-mol, Kodimuli* ; Tel.—*Yerra-chitra.*

PLUMBAGO ZEYLANICA (N.O. Plumbagineæ)

VERN.—Sans.—*Agni-shikha, Chitraka* ; Hind.—*Chitra, Chita, Chiti* ; Beng.—*Chita, Chitruk* ; Uriya.—*Chita* ; Punj.—*Chitrak* ; Guj.—*Chitaro* ; Tam.—*Chittira, Chittira-mulam* ; Tel.—*Chitra-mulam.*

Plumbago rosea is a shrubby perennial frequently met with in gardens in Bengal. The plant grows throughout India particularly in the United Provinces, Bengal and Southern India. *P. zeylanica* is an allied species and is considered to be a cultivated variety of *P. rosea.* The root of these plants has been quite well-known in our country for a very long time and there are references to it in the classical works of Charaka, Susruta etc. It is believed to increase the digestive powers, it promotes the appetite and is said to be useful in dyspepsia, piles, anasarca, skin diseases, etc. As a local application, the root was held in high esteem and it entered into the composition of several caustic preparations. The roots have been largely used

as abortifacients in the indigenous practice. With this object it is sometimes given internally but more commonly it is employed as a local irritant to the os uteri. It is also used as an irritant to the skin by malingerers or to support false charges.

Chemical Composition :—Dulong (1885) first isolated an active principle from the root of Plumbago and named it 'plumbagin'. Flückiger (1889) isolated the same substance in a slightly purer form from the root of *P. zeylanica* by submitting it to steam distillation and extracting the distillate with ether. Bettinck (1888) also isolated plumbagin from P. *rosea* in the form of yellow needles, melting at 72°C. Roy and Dutt (1928) have found that plumbagin is present in all the varieties of plumbago met with in India to a maximum of about 0.91 per cent. The proportion of plumbagin varies within wide limits according to the locality, growth, age, condition of the soil and season of the year. In general it is found by these workers, that the older the plant and the drier the soil, the greater is the quantity of active principle found in the roots. It has also been found that fresh roots yield a much greater proportions of plumbagin than roots which have been stored for a considerable time.

Pharmacological action :—Keien Ko (1931) studied the pharmacological action of plumbagin. He finds that it stimulates the central nervous system in small doses while with larger doses, paralysis sets in leading ultimately to death. The blood pressure shows a slight fall. The stimulant action is not properly observed in the isolated heart of the frog. The peripheral vessels are found to dilate. Small doses stimulate the plain muscle all over the body, but large doses produce immediate paralysis. The minimum lethal dose has been found to be 0.5 *mgm. per gm. of frogs,* 0.1 *mgm. per gm. of mice and* 10 *mgm.* per kilogram of rabbits. Vyas and Lall of Lucknow (unpublished) have found that plumbagin is a powerful irritant and has well marked antiseptic properties. In small doses, the drug is a sudorific ; large doses causes death from respiratory failure. The action is probably due to the direct effect of the drug on the muscles.

Therapeutic Uses :—As plumbagin is a potent remedy it is likely to be of use in therapeutics if its dosage is properly regulated by proper pharmacological studies. Owing to its property of setting up irritation of the skin, it may be of use in chronic skin diseases and in leucoderma. Vyas and Lal have

got fairly good results from its use in early cases of leucoderma and baldness of the head but further work is necessary.

References :—

(1) Roy, A. C. and Dutt, S., 1928, *Journ. Ind. Chem. Soc.*, Vol. V, p. 419; (2) Keien Ko, 1931, *Japanese Jour. Med. Sciences* (Pharmacology).

PONGAMIA GLABRA (N.O. Leguminosæ)

VERN.—Sans.—*Karanja, Naktamala* ; Hind.—*Karanj, Kiramál, Sukhchain* ; Beng.—*Dahar-karanja* ; Mar.—*Karanja* ; Tam.—*Pungam-maram* ; Tel.—*Kanuga-chettu,* Can.—*Honge.*

Pongamia glabra is one of the commonest trees in India especially near the coast, and is met with from the Central and Eastern Himalayas to Ceylon. It is a small handsome tree with glabrous, bright green foliage. The seeds, leaves and the oil derived from the seeds are all used in Hindu medicine as remedies for skin diseases and rheumatism. A bath prepared from the leaves is used for relieving rheumatic pains and the juice of the root is used for cleansing foul ulcers and sores. The oil is held in high esteem as an application in scabies, herpes and other cutaneous diseases. Internally, the oil has sometimes been used as a stomachic and cholagogue in cases of dyspepsia with sluggish liver. The powdered seeds of *Pongamia glabra* are supposed to be of value as a febrifuge and tonic in asthenic and debilitating conditions. They are also used very commonly for their expectorant properties in bronchitis and whooping cough.

Chemical Composition :—The seeds contain 27 to 36.4 per cent. of a bitter fatty oil (Pangamol or Hongay oil). The oil is brown in colour and has a characteristic odour. The colour can be largely removed by treatment with alkali and the odour by treatment with superheated steam under reduced pressure. The fatty acids present in the oil include myristic (0.23), palmitic (6.06), stearic (2.19), arachidic (4.30), lignoceric (3.22), dihydroxystearic (4.36), linolenic (0.46), linolic (9.72) and oleic acid (61.30 per cent.) together with 3.56 per cent. of unsaponifiable matter. Investigations carried on in the department of chemistry at the School of Tropical Medicine show that, besides

the fixed oil, the seeds contain traces of an essential oil. Nearly 250 gm. of the powdered seeds were distilled in steam and only a trace of an essential oil was obtained. The characters of the oil have not been definitely determined as yet.

Pharmacological Action and Therapeutic Uses:—The finding of an essential oil in the seeds of *Pongamia glabra* is significant and in view of the popularity of the seeds in certain districts as a remedy for troublesome cough, it was thought that the essential oil present in the seeds might have some part to play in the therapeutic efficacy of the drug. A portion of the steam distillate containing the essential oil was, therefore, passed through the pharmacological tests to find out the nature of the action of the oil. The steam distillate, on intravenous injections in experimental animals, is found to cause a slight rise in blood pressure which is of a transient nature. The bronchioles appear to be slightly relaxed. Further work is in progress.

References :—

(1) Lewkowitsch, 1905, *Oils and Fats*, Vol. II, p. 269;; (2) Katti, B., 1926, *J. Pharm, Assoc.*, Vol. 14, p. 1086; (3) Desai, Sudborough and Watson, 1923, *Jour. Ind. Inst. Sci.*, Vol. 6, p. 93.

PSORALEA CORYLIFOLIA (N.O. Leguminosæ)

Babchi

VERN.—Sans.—*Vakuchi* ; Hind.—*Babchi, Babachi* ; Beng.—*Latakasturi, Bavachi* ; Bomb.—*Bawachi* ; Tam.—*Karpo-karishi* ; Tel.—*Karu-bogi.*

Psoralea corylifolia is a common herbaceous weed which grows throughout the whole length and breadth of the plains of India. The seeds of this plant have been in use in the Hindu medicine for a long time. They are brownish black in colour, about 2 mm. long and are oblong and flattened. They are hard but not brittle, have a soft skin, an agreeable aromatic odour and a pungent bitterish taste. No oil can be expressed from the seeds even under high pressure. A good quality of the seed is produced in Rajputana which can be bought in the market at Rs. 15/- to Rs. 20/- per maund.

The seeds have been described by the ancient Hindu physicians as 'hot and dry' and according to some 'cold and dry, laxative, fragrant, stimulant and aphrodisiac'. They have been specially recommended in leprosy internally and are also applied in the form of paste or ointment externally. The drug has been considered to be so efficacious in this disease that it was given the name of 'kushtanasini' (leprosy destroyer). In inflammatory diseases of the skin, leucoderma and psoriasis it is given both as a local application and by the mouth. The seeds are also used as an anthelmintic, diuretic and diaphoretic in febrile conditions. Several species of Psoralea grow in America and are used medicinally in that country as a stimulant and as nervine tonic.

Chemical Composition:—Dymock in his *Pharmacographia Indica* states that the seeds contain a colourless oil, 13,2 per cent. of extractive matter, albumin, sugar, ash 7.4 per cent. and a trace of manganese. Very little work was done on this drug until recently, when Sen, Chatterjee and Datta (1923) made a thorough examination of the seeds. These authors found that the seeds contained—(1) an unsaponifiable oil having the formula $C_{17}H_{24}O$ boiling between 180° and 190°C at 11 to 15 mm.; (2) a yellow acid substance $C_{40}H_{45}O_{10}$ from the alcoholic extract; (3) a methyl glucoside having a melting point of 105° to 107 C containing four (OH) groups. They found the unsaponified oil to be pharmacologically active and they used it with success in cases of leucoderma and psoriasis. They did not, however, study the essential oil present in the seeds, which was associated with the unsaponifiable oil.

Chopra and Chatterjee (1927) studied the chemistry of the seeds. The chief active principle is an essential oil. A fixed oil, a resin, and traces of a substance of alkaloidal nature are also present. The essential oil was more closely studied by these workers.

The crushed seeds were distilled in steam and the distillate collected. The distillate was saturated with common salt, when most of the oil floated at the top and was repeatedly extracted with ether. The ethereal extracts were collected and dried with anhydrous sodium sulphate. On slowly evaporating the solvent a straw-coloured essential oil having the characteristic odour of the seeds was obtained, the yield being 0.05 per cent.

The following constants were determined :—Sp. gr. at 25°, 0.9072; refractive index 1.5025; solubility in water at 25° about 0.0197 per cent. It was found to be optically inactive.

The essential oil when stored in a sealed tube remained unchanged for a considerable period; the colour, however, gradually turned to a

deep brown. When placed in a desiccator over calcium chloride or exposed to air, it crystallised in needles, probably on account of the oxidation of some of its constituents. The crystals had a sharp cooling taste; they melted sharply at 126°C. If the temperature was further raised to 330°C, they slowly turned black, showing the decomposition of the substance at a high temperature. On cooling it was found that a well-defined needle-shaped crystalline sublimate had deposited on the cooler parts. As the quantity of the essential oil at our disposal was very small, it could not be fractioned *in vacuo* to study its constituents.

Preparation of the Oleo-resinous Extract for Clinical Trials:—One pound of the powdered seed was thoroughly mixed with 1 lb. of olive oil and the mixture was kept overnight. Next day, it was transferred into a tincture press and the oil was expressed. About half a pound of oil was collected and filtered through cotton wool. The oil was diluted with fresh olive oil according to requirements.

Pharmacological Action of the Essential Oil:—The oil has an irritant effect on the skin and mucous membrane. Its action on undifferentiated protoplasm such as paramœcium is quite marked. In 1 in 50,000 dilutions of the essential oil, the paramœcia remain alive and active for 15 minutes; after 25 minutes the movements are somewhat slowed and some die in 40 to 45 minutes. In 1 in 10,000 dilution these organisms are killed in 10 minutes. The essential oil shows a selective activity against the skin streptococci and this in all probability accounts for its extensive use by the Hindu physicians in skin affections. Dilutions of 1 in 10,000 kill streptococci in 10 minutes. Against *B. typhosus* (Calcutta strain) the essential oil has no activity at all and there was growth of these bacilli in all concentrations. The action of the essential oil on the cholera vibrio and *B. dysenteriæ* was tried with results similar to those obtained with *B. typhosus*. The following table gives the relative effects of 1.0 per cent. phenol and different dilutions of the babchi essential oil on the skin streptococci :—

	Time in minutes			
	2½	5	7½	10
Phenol, 1.0 per cent. ...	−	−	−	−
Saturated aqueous solution of essential oil (1 in 5,000)	+	−	−	−
Dilution 1 in 10,000 ...	+	+	+	−
,, 1 in 25,000 ...	+	+	+	+
,, 1 in 50,000 ...	+	+	+	+

+means growth; −means no growth.

On voluntary muscle, the essential oil in high dilutions (1 in 50,000 to 100,000) has a distinct stimulant action. The tone of the

isolated uterus of the guinea pig or cat is decidedly increased and the uterus may show a tonic contraction. Perfused, isolated pieces of intestine are similarly affected and the peristaltic movements are increased. Saturated solutions of the oil injected intravenously have no effect on the blood pressure. The isolated mammalian heart shows neither stimulation nor depression. On perfusion with 1 in 5,000 solution of the oil there is a well-marked contraction of the arterioles in a frog. The respiration is not affected.

Therapeutic Uses:—Psoralea corylifolia is a very ancient remedy for leucoderma; it has been tried extensively not only by the practitioners of the Hindu medicine but also by followers of the Western system. K. L. Dey strongly recommended an oleo-resinous extract and he describes the effects as follows:—"After application for some days the white patches appear to become red or vascular; sometimes a slightly painful sensation is felt. Occasionally, small vesicles or pimples appear and if these be allowed to remain undisturbed, they dry up, leaving a dark spot of pigmentary matter, which forms as it were a nucleus. From this point as well as from the margin of the patch, pigmentary matters gradually develop, which ultimately coalesce with each other and thus the whole patch disappears. It is also remarkable that the appearance of fresh patches is arrested by its application." Other observers have not obtained such good results.

Acton (1926) tested a number of preparations made from *Psoralea corylifolia* seeds in various skin affections at the Skin Out-patient Department, Calcutta School of Tropical Medicine, 1 in 10,000 to 1 in 20,000 solutions of the pure essential oil were tried in some cases of acute streptococcal dermatitis, but unfortunately they set up much irritation and made the condition worse. A 20 per cent. solution of the purified resin in alcohol was quite ineffective in leucoderma. A 1.0 per cent. solution of the essential oil in alcohol was also unsatisfactory. The oleo-resinous extract made from the seeds was found to be the most suitable preparation; this contains most of the essential oil present in the seeds. This oil was applied locally to leucodermic patches by gently rubbing once or twice daily. Patients suffering from leucoderma are divided into two groups:—

1. *The primary group*:—These patients do not suffer from any other skin disease. They are sub-divided into (*a*) those of syphilitic origin and (*b*) those of non-syphilitic origin. Some of them suffer from *E. histolytica* infection and other affections of the gastro-intestinal tract, others are free from it.

2. *The secondary group*:—This includes cases which are associated with other diseases of the skin such as ringworm, seborrhœic dermatitis, etc.

The oleo-resinous extract has been tried in a very large number of cases of leucoderma of both groups, but its beneficial effects are observed only in the non-syphilitic groups. In the syphilitic cases it had no effect, because here in all probability the melanoblasts are killed, as they are not visible in the histological preparations. The effect of the essential oil is purely local. The Hindu physicians give the powdered babchi seeds by the mouth but this method was not tried in the treatment of leucoderma. The beneficial effects may be due to—(1) absorption and excretion of the oil through the skin where it produces its specific action, (2) stimulant action on the intestinal mucosa which may cause increased absorption of amino acids concerned in pigment formation, or (3) antiseptic action in the gastro-intestinal tract, but this is not borne out by our experiments. The effect of the essential oil is purely local and, therefore, any existing concurrent affections of the gut such as infection with *E. histolytica* should be treated at the same time. The action of the oil on the skin appears to be specific. Krogh has demonstrated that Rouget's cells lie round the capillaries. The endothelium of the capillaries by itself has no contractile power and any increase or diminution in the size of these vessels is brought about through the agency of the processes of Rouget's cells. In the skin the melanoblasts or pigment-producing cells lie in the vicinity of Rouget's cells. When the capillaries dilate Rouget's cells also increase in size and the melanoblasts relax at the same time. During relaxation of the melanoblasts their processes are extended and they exude the pigment *melanin*. The main action of the essential oil appears to be on the arterioles in the sub-capillary plexuses causing dilatation and increase of plasma in this area so that the skin

becomes red and the melanoblasts are stimulated. The action on the capillaries in the papillæ is usually very slight in most individuals so that there is no œdema of the prickle cells layer (poro-keratosis) and there is no desquamation of the epithelium.

The essential oil, however, varies enormously in its effects on different persons. With the majority (95 per cent.) it causes only redness of the leucodermic patches but in a small number (5 per cent.) there is extreme sensitiveness to the oil, so much so that blistering may be produced. This indicates that not only is dilatation of the blood vessels produced, but at the same time the permeability of the capillary tufts is markedly increased so that fluid accumulates and blisters form between the prickle cells and the capillary layer of the skin. In yet another class of cases blistering only occurs after the application of the oil if the skin is exposed to the direct rays of the sun. The strength of the oil should, therefore, be varied in such a way as not to allow its action to go beyond the state of redness of the leucodermic patches. The oil being an essential oil is able to permeate through the epidermis to the prickle cells of the lymphatics and so it finds its way to the sub-capillary area and stimulates the cells situated there. The advantage of this oil over the other skin irritants (compounds of mercury, salicylic acid, etc.) is that it does not produce desquamation or any change of keratolytic nature resulting in loss of pigment of the epidermis. So far as is known *Psoralea corylifolia* is the only drug that has a dual action, *i.e.*, action on both Rouget's cells and the melanoblastic cells of the skin. This specific action of the oil can be readily demonstrated on the frog's skin under a microscope. In leucoderma the melanoblastic cells are not functioning properly and their stimulation by the oil leads them to form and exude pigment which gradually diffuses into the decolorised areas.

Summary:—The active principle of the seeds of *Psoralea corylifolia* (babchi) is an essential oil. A fixed oil and a resin occur in large quantities but these are not pharmacologically active substances. Traces of substances of alkaloidal nature are also present. The essential oil has a powerful effect against the skin streptococci. It has a specific effect on the arterioles

of the sub-capillary plexuses which are dilated so that in this area plasma is increased. The skin becomes red, the melanoblasts are stimulated leading to pigment formation. The pigment is exuded and diffuses into the decolourised leucodermic patches. Local applications of the oleo-resinous extracts made from the seeds are beneficial in the treatment of cases of leucoderma of non-syphilitic origin. If affections of the gastro-intestinal tract such as *E. histolytica* infections, etc., are present, these should be treated at the same time.

References :—

(1) Dey, K. L., 1881, *Pharmaceutical Journal*, September 24; (2) Sen, Chatterjee and Dutt, 1923, *Indian Journal of Medicine*, Sept.; (3) Chopra, R. N. and Chatterjee, N. K., 1927, *Ind. Jour. Med. Res.*, Vol. XV, p. 49.

RAUWOLFIA SERPENTINA (N.O. Apocynaceæ)

VERN.—Sans.—*Sarpagandha, Chandrika*; Hind.—*Chota-chand*; Beng. and Bomb.—*Chandra*; Bihar and Orissa—*Dhan-marna* or *Dhan-barua*; Tam.—*Covannamilpori*; Tel.—*Patala-gandhi*.

It is a large climbing or twining shrub found in the tropical Himalayas and in the plains near the foot of the hills from Moradabad to Sikkim. It occurs in Assam, Pegu, Tennasserim at altitudes up to 4,000 ft. and in the Deccan Peninsula along the Ghats to Travancore and Ceylon. It grows wild in many districts of North Behar and in Patna and Bhagalpur. It is also obtainable in Java and Malay Peninsula. The root of *Rauwolfia serpentina* has been much valued in India and the Malayan Peninsula from very ancient times as an antidote for the bites of poisonous reptiles and the stings of insects. It has also been used as a febrifuge in many places. It is said to stimulate the uterine contractions and promote the expulsion of the fœtus. Recently the drug has attained prominence as a remedy for insomnia, hypochondria, etc. There is no mention of this property in any book on Indian medicinal plants. The hypnotic action of the drug appears to have been known to the poorer classes in Bihar and the practice of putting children to sleep

by this drug is stated to be still present in certain parts of that province. In the United Provinces and Bihar, the drug is sold as 'pagal-ka-dawa' (insanity specific) and its use is common amongst the practitioners of the indigenous medicine. The popularity of the root may be estimated from the fact that many maunds are consumed every year in Bihar alone.

Chemical Composition :—On account of the popularity of the drug in the indigenous medicine, chemical examination of the roots has been carried out by a number of workers. Sen and Bose (1931) have found two alkaloids in the root with different melting points. The quantity of the total alkaloids has been estimated to be fairly high amounting to about 1 per cent. of the dried roots. The root also contains a lot of resin and starch and when incinerated leaves about 8 per cent. of ash consisting mainly of potassium carbonate, phosphate, silicate and traces of iron and manganese.

S. Siddiqui and R. H. Siddiqui (1931) have found five new alkaloids to which they have given special names as follows :—

Group A—Ajmaline group, consists of three white crystalline weak bases.

1.—*Ajmaline* ($C_{20}H_{26}O_2N_2$), M.P. 158-60° (0.1 per cent.).
2.—*Ajmalinine* ($C_{20}H_{23}O_4N$), M.P. 180-81° (0.05 per cent.).
3.—*Ajmalicine* ... M.P. 250-52° (0.02 per cent.).

Group B—Serpentine group—two bright yellow crystalline stronger bases.

1.—*Serpentine* ($C_{21}H_{23}O_4N$), M.P. 153-54° (0.08 per cent.).
2.—*Serpentinine*, M.P. 263-265° (decomposes) (0.08 per cent.).

Other constituents identified are :—(*a*) a phytosterol, (*b*) oleic acid, and (*c*) unsaturated alcohols of formula $C_{25}H_{44}O_2$.

Chemical examination is also being conducted in the Department of Chemistry, Calcutta School of Tropical Medicine and Hygiene. Only one alkaloid has so far been isolated in a pure state. It has a melting point of 202°C and is fairly soluble in all organic solvents, *viz.*, alcohol, ether, chloroform, benzene, but is insoluble in petroleum ether. It crystallises from methyl alcohol in tufts of colourless prisms and has an extremely bitter taste. It is very slightly soluble in hot water. The hydrochloride of the base crystallises from water in colourless boat-shaped or prismatic needles, slightly soluble in cold water but fairly soluble in hot water. It melts at 135°C and has a very bitter taste. It gives a green fluorescence in watery solution. Further work is in progress.

Pharmacological Action :—The pharmacological actions of the active principles of the drug have not yet been worked out

satisfactorily. According to Siddiqui and Siddiqui (1931), the white and yellow bases isolated form two distinct groups from the standpoint of physiological action. The former (Ajmaline group) acts as a general depressant to the heart, respiration and nerves and the latter (Serpentine group) paralyses the respiration and depresses the nerves but stimulates the heart. These observations were drawn from experiments carried out on frogs and, therefore, cannot be interpreted *in toto* in higher animals. The lethal dose of the serpentine group of alkaloids was found to be the same as that of the ajmaline group, *viz.*, 0.5 gm. per kilogram of frog. The lethal dose for rats was found to be four times higher. Sen and Bose (1931) studied the pharmacological action of the drug on higher animals, *e.g.*, cats. They found that the watery extract of the whole drug when injected intravenously in animals produces no appreciable effect. The resins have also been separately tried but without much effect on the system excepting a slight stimulation of the uterine musculature. The alkaloids isolated by them, however, showed very definite results. The blood pressure showed a slight fall and the respiration was slightly stimulated. The heart muscle was depressed and the plain muscle like that of the small intestines, uterus, etc., was relaxed. The drug is not an irritant when taken by the mouth or when introduced into the system by hypodermic or intramuscular injections. Roy (1931) finds that the reflexes and the sensation of pain are not affected by ordinary doses of the drug ; if, however, the dose is large it produces deep sleep, the reflexes and sensation of pain are diminished and death may result from asphyxia due to paralysis of the respiratory centre. The heart goes on beating for some time after the failure of respiration. The pharmacological action of the drug is being studied in detail in the Department of Pharmacology, School of Tropical Medicine, and the results will be published in due course.

Therapeutic Uses :—The popularity which the drug has attained as a specific for insanity amongst lay people shows that it probably possesses well-marked sedative properties. The drug has been tried by Sen and Bose in cases of insanity with

violent maniacal symptoms and in cases of high blood pressure. Doses of 20 to 30 grains of the powdered root twice daily produce not only sedative effects but also a reduction of the blood pressure. Within a week the patient's senses are said to be restored, though in certain cases the period of treatment has to be prolonged. In high blood pressure without marked atheromatous changes in the vessels, these authors find the drug very satisfactory. Claims regarding its utility in fevers and during the puerperium have not been thoroughly tested, but it would certainly be worth while to try the drug on a more extensive scale. From the data so far obtained, it promises to be a valuable addition to the list of existing sedatives in insanity and irritative conditions of the central nervous system. A large amount of pharmacological and clinical study will have to be done before the utility of the drug is fully established.

References :—

(1) Sen, G., and Bose, K., 1931, *Ind. Med. World*, July; (2) Siddiqui, S., and Siddiqui, R. H., 1931, *Jour., Ind. Chem. Soc.*, Vol. VIII, p. 667, (3) Roy, P. C., 1931, *The Patna Journal of Medicine*, October.

SARACA INDICA (N.O. Leguminosæ)

The Asoka tree

VERN.—Sans.—*Asoka, Kankeli* ; Hind., Beng. & Bomb.—*Asok* ; Uriya—*Asoka* ; Guj.—*Ashopalava.*

Saraca indica is one of the sacred trees of the Hindus and is found plentifully along the roadside in Eastern Bengal which is probably its original home. It grows abundantly in South India, Aracan and Tenasserim. In the United Provinces, near Kumaon, the tree occurs up to an altitude of 2,000 feet. It is cultivated in many parts on account of its handsome flowers. The bark of the tree is largely prescribed in Ayurvedic medicine as an astringent and uterine sedative. It is said to have a stimulating effect on the endometrium and on the ovarian tissue. It is largely used in uterine affections, especially menorrhagia due to uterine fibroids and other causes. A decoction in milk is one of the most favourite

prescriptions of the Kavirajes even to this day. It has also been used in hæmorrhoids and dysentery.

Chemical Composition:—The chemistry of the bark has not been worked out satisfactorily. Abbott (1887) stated that it contained hæmatoxylin. Hooper (Pharm. Indica) recorded the presence of a fair amount of tannin. The dry powdered bark was extracted with different solvents in the Department of Chemistry of the School of Tropical Medicine with the following results:—petroleum ether extract 0.307 per cent., ether extract 0.235 per cent., and absolute alcoholic extract 14.2 per cent.

The alcoholic extract, which was mostly soluble in hot water showed the presence of a fair amount of tannin and probably an organic substance containing iron. No active principles of the nature of alkaloid, essential oil, etc., were found. Further investigations are being carried on.

Pharmacological Action and Therapeutic Uses:—Various fractions isolated from the bark were tried on the isolated uterus and uterus *in situ* but no marked action was produced. The drug does not appear to have marked therapeutic effects, though many clinicians appear to vouch for its efficacy in menorrhægia and other uterine disorders.

SAUSSUREA LAPPA (N.O. Compositæ)

The Costus

VERN.—Sans.—*Kushtha, Kashmirja*; Hind.—*Kut, Kust*; Beng.—*Pachak, Kur*; Bomb.—*Ouplate*; Tam.—*Goshtam*; Arab. & Pers.—*Kust*.

Saussurea lappa is a tall, stout herb having an annual stem and perennial roots. Many species of Saussurea grow in the Himalayas at an altitude ranging from 2,000 feet to 13,000 feet above the sea level. The only species which has been used for its medicinal properties is *S. lappa* which grows in the north-western portion of the Himalayas, especially on the moist slopes of the mountains round the valley of Kashmir. The plant is well-known both in the Ayurvedic and Tibbi medicine. For a long time a good deal of confusion existed as to which one of the large number of species of Costus was

used for its medicinal properties by the ancients, but Guibourt first suggested the correct botanical source and Falconer, who visited Kashmir, proved beyond doubt that the root of *Aucklandia costus*—now known as *Saussurea lappa*—was the species. The plant grows as a very stout herb with large heart-shaped leaves, and thick perennial roots which are dug up in the autumn and are exported to Calcutta and Bombay in large quantities. From there the root is shipped to China in large quantities and to the Red Sea ports, and is used as a spice, as an incense and medicinally. The uses of this root have been summarised by Baden Powell in his 'Punjab Products' in the following terms :—

"1. Dried and powdered as the principal ingredient in an astringent stimulant ointment, applied to severe ulcerations.

2. Dried and powdered as a hair wash.

3. As a stimulant in cholera ; an infusion made of cardamoms 1 dr., fresh kut 3 drachms, water 4 ounces. One ounce every half hour. It is doubtless a powerful aromatic stimulant, and would be serviceable in any spasmodic disease.

4. It is universally employed by shawl merchants as a protector of Kashmir fabrics from the attacks of moth and other vermins.

5. The dried root is an agreeable fumigatory and yields excellent pastilles which burn fairly well.

6. It is exported in enormous quantities to China, where it is used as an incense. In every Hong it is found ; no mandarin will give audience until the 'patchak' incense smokes before him ; in every Joss-house it smoulders before the Tri-budh deity ; in every floating junk in the Chinese rivers, the only home of countless hordes—Budh's image is found, and the smoke of the 'patchak' religiously wends its way heavenwards. . . . . . It is said to have the power of turning grey hair black. Carminative, stimulant, antiseptic, prophylactic, astringent, sedative and insecticidal properties are ascribed to this remedy. The Chinese apply it with musk to aching teeth."

The root is smoked in parts of India and in China as a substitute for opium.

The Kashmir State authorities have found such a large demand for this root that they have started nurseries and cultivate the plant in suitable places for purposes of export. The value of the root may be judged from the fact that its market price in Calcutta at the present time is over Rs. 300/- per maund, *i.e.*, about five rupees or seven shillings per pound. For this reason the root offered for sale is frequently adulterated with the root of *Salvia lanata* or *Ligularia* and one of the aconites.

The root only is used in medicine. It is dug up during the months of September and October and is collected in small pieces 2 to 6 inches long. It has a pungent taste, a peculiar fragrant aromatic odour resembling that of the orris root. In the Hindu medicine the root has been used from the earliest ages. It has been described in the 'Nighantu' as a stimulant, useful in cough, fever, dyspepsia, skin diseases and as an aphrodisiac. It is said to be particularly useful in the disease arising from deranged air and phlegm and asthma. The Mohammedan physicians describe it as a diuretic and anthelmintic and use it in the treatment of quartan malaria, leprosy, persistent hiccough and rheumatism. The dried powder is the principal ingredient in a stimulating ointment used for application to ulcers. It also forms part of a stimulating mixture used against cholera asiatica.

Chemical Composition :—This drug was analysed many years ago (1892) by Schimmel & Co., was found to contain about 1.0 per cent. of an essential oil with a strong fragrant odour. The root forms a very valuable raw material for producing a perfume which closely resembles the violet perfume, and is at present very highly priced. Later, Semmler and Feldstein thoroughly studied the oil and found that it had the following approximate composition :—

Camphene 0.04 per cent.; phellandrene 0.4 per cent.; terpene alcohol 0.2 per cent.; α-costene 6.0 per cent.; β-costene 6.0 per cent.; aplotaxene 20.0 per cent.; costol 7.0 per cent.; di-hydrocostus lactone 15.0 per cent.; costus lactone 10.0 per cent.; costic acid 14.0 per cent.

Little or no attention was paid to the other constituents of the root although Hooper referred to the presence of small quantities of a body of alkaloidal nature. Later, Ghosh and his collaborators (1929) reinvestigated the root and succeeded in isolating an alkaloid. The following constituents were separated by them from the root :—(1) An *essential oil* 1.5 per cent.; (2) an alkaloid for which the name *saussurine* has been suggested 0.05 per cent.; (3) resin about 6.0 per cent.; (4) traces of a bitter substance; (5) small quantities of tannins; (6) inulin about 18.0 per cent.; (7) fixed oil; (8) potassium nitrate, sugars, etc. The leaves of *S. lappa* have also been analysed. They do not contain the

essential oil but 0.025 per cent. of the same alkaloid as is contained in the root.

PHARMACOLOGICAL ACTION :—*Essential Oil.*—In such dilutions as 1 in 10,000 the essential oil kills *Paramæcium caudatum* in 10 minutes. It has strong antiseptic and disinfectant properties especially against the streptococcus and staphylococcus. Internally, the oil has a pungent, bitter taste and gives rise to a feeling of warmth in the stomach when taken in small quantities. When the extract made from the root is given by the mouth in such large doses as 10 to 20 c.c., it gives rise to a certain amount of irritation and a feeling of discomfort in the abdomen which may last for several hours, the patient at the same time feeling somewhat drowsy. The essential oil has marked carminative properties. On the isolated intestines of the rabbit even in such high dilutions as 1 in 120,000 it has the effect of inhibiting the peristaltic movements and producing relaxation of the gut. *Vaso-dilatation is produced in the splanchnic area after intra*venous injection of the essential oil. On the circulation the essential oil produces a definite stimulant action. A saturated solution of the oil given intravenously in experimental animals, produced a small but persistent rise of blood pressure; the isolated heart of the rabbit showed a distinct acceleration of both the amplitude and the rhythm. On the lungs, intravenous injections of the essential oil had a broncho-dilator action. It is absorbed from the gastro-intestinal tract and is partly excreted by the lungs producing an expectorant action and partly by the kidney producing diuresis. On the central nervous system the effect of the essential oil resembles that of other volatile oils. Large doses of the extract produce giddiness, headache and drowsiness which cannot be attributed to any of the other active principles. Inhalation of smoke of the powdered root produces a marked depression of the central nervous system and for that reason it was smoked as a substitute for opium.

The Alkaloid Saussurine :—Chopra and De (1929) investigated the effect of saussurine tartrate on the involuntary muscle tissue generally and on the lungs and bronchi particularly. It was shown that in animals the alkaloid produced a definite relaxation of the bronchioles in the same way as adrenaline does. The action was not so powerful as that of adrenaline, takes longer to develop but persists for a much longer time. The alkaloid appears to act chiefly through the vagus centre in the medulla, though direct action on the involuntary muscle fibres of the bronchioles has also some part to play. Saussurine also has a general depressing action on the other involuntary muscle tissues in the body. It decreases the tone of the intestine and stops the peristaltic movements of the gut, if it is given intravenously in animals. The action is partly on the vagus but chiefly on the muscle fibres themselves. Intravenous injections of the alkaloid produce a slight rise of blood pressure in animals due to stimulation of the myocardium. The effect is much more

marked on the ventricles than on the auricles. The administration of saussurine revives a failing heart, the beats becoming regular and forceful.

Therapeutic Uses:—Following up the anti-spasmodic, broncho-dilator and expectorant actions of the drug, it was extensively tried in the treatment of bronchial asthma. The preparation used for administration was an alcoholic extract prepared from the root, which contains the essential oil as well as the alkaloid; this was given in ½ to 2 drachm doses. This is prepared in the following manner:—

The powdered root (40 mesh) is percolated 6 to 8 times with 90 per cent. alcohol in the cold till nearly exhausted. The major portion of the alcohol is distilled off and the residual extract is concentrated so that 1 c.c. of the extract corresponds to 1 gm. of the air-dried drug.

It has already been shown that saussurine has a depressant effect on the vagal tone. At the same time the essential oil during its excretion into the bronchial mucosa not only relaxes the involuntary muscle fibres of the bronchioles but also liquefies the tenacious sputum and produces a well-marked expectorant action. In this way not only is the spasm relaxed but the congestion of the bronchial mucosa is also relieved. The respiratory passages are thus cleared and the attack is subdued. The author's experience, so far as asthmatics in this country are concerned, is that although they suffer from hyper-excitability of both the para-sympathetic and sympathetic systems, they show a greater degree of irritation of the vagus than that of the sympathetic. The action of the vagus is increased owing to certain causes not only producing spasm of the bronchial musculature but also vaso-dilatation of the bronchial mucosa. These effects can be relieved by atropine and to a much lesser degree by inhalation of fumes of stramonium, tobacco leaves, etc., which diminish the vagus action, or adrenaline, ephedrine, etc., which stimulate the antagonistic action of the sympathetic. In the vagal predominance adrenaline has only a slight and evanescent effect in overcoming attacks. Not uncommonly the injection of a few minims of this drug may produce a high rise of blood pressure and irregular action of the heart. Neither adrenaline nor ephedrine

are suitable in these patients and we have to look for something which will depress the vagal mechanism. The disadvantage of atropine and allied substances is that although they depress the terminations of the vagi they do not relieve the turgescence of the bronchial mucosa. In fact, on account of their tendency to decrease the secretion, they make the suptum more viscid and difficult to expectorate. This is the reason why they are often combined with such drugs as potassium iodide which render the sputum more fluid. This would also explain the beneficial effects produced by *S. lappa* in the vagotonic type of asthma. The drug fails in those patients in whom the causal factors are very potent. Such patients have a high degree of eosinophilia, which is an indication that strong toxic bases are being absorbed into the circulation from some focus, where such factors as a lesion in the nose, enlarged lymphatic glands in the chest, pathological change in the gastro-intestinal tract, etc., are present. Even in these patients the drug gives some relief though it may be temporary.

Besides the direct depressant action of the alkaloid on the vagal centre there is another important factor concerned in the anti-spasmodic effect of the drug and that is the reflex inhibition produced by the essential oil, which is an irritant and has a strong penetrating and persistent odour and taste when it enters the stomach. The depressant action of the drug on the algesic areas of the brain also further helps in relieving the spasm. All these factors undoubtedly account for the rapid effect of the drug in cutting short the paroxysms and stopping further attacks when the extract is being given. The strong smell and the taste of the drug though advantageous in one way have disadvantages also. There are some patients, fortunately a small minority who cannot take the drug on this account and if it is forced on them they vomit it.

The extract is either given by itself in a little water or in the form of a mixture, *e.g.*, pot. iodide or pot. bromide gr. v to x, tr. belladonna m. iii to v, tr. lobelia ætheris m. x., ext. Saussurea lappa liq. ½ to 1 dr., spt. chloroformi m. x., aqua ad one ounce.

The patient is generally advised to take the mixture 3 to 4 times a day and keep a dose by his side when he goes to bed at night. This should be taken immediately when the premonitions of an attack are felt, the paroxysm is usually aborted and the patient goes to sleep again. The disturbance of sleep produced is comparatively much less than if an injection of adrenaline has to be taken or an asthma cigarette has to be smoked. The depressant action of the drug on the central nervous system further helps the patient to fall quickly to sleep. It is better to give the extract by itself, when the drug is being administered to cut short a paroxysm. The author prefers to prescribe it in a mixture, specially when the administration has to be continued for some time to prevent further recurrrence of the attacks while the causal factors are being investigated. The drug has no cumulative effect and, therefore, it can be continued for long periods without producing ill effects. No marked tolerance to the drug is observed so that there is no necessity for the dose to be increased. It is preferable to give it for ten days or a fortnight and then to stop it to see if the attacks recur. In many patients in whom the paroxysms are merely due to irritation through some temporary and not a deep-seated cause, the extract combined with general treatment frees the patient for months or years from attacks and the paroxysms do not recur till these factors operate again. It should be understood, however, that the treatment of this symptom-complex is not so easy as would appear. The cause giving rise to the attacks should be discovered and remedied, but this often is not an easy matter and may take considerable time. Unless this is done, a permanent cure cannot be expected.

In the indigenous medicine in India the root of *S. lappa* is used as an aphrodisiac and as a tonic. It has already been pointed out that the essential oil is excreted in the urine and during its passage through the urethra it may produce a certain amount of irritation giving rise to aphrodisiac effects. In the old Sanskrit books the drug has been suggested as a remedy for malaria. It has been tried in a number of cases of different types of this disease with no benefit whatever. The Moham-

medan physicians recommend it against rheumatism, as an anthelmintic and against persistent hiccough. While we have undoubtedly obtained beneficial results in the last-named condition, we are unable to attribute any anthelmintic properties to the drug. We have tried the powdered root as well as the alcoholic extract against hookworm, ascaris, trichuris and tænia infections with entirely negative results. Experiments *in vitro* with a number of these entozoa also showed that the drug was entirely without effect even in very high concentrations. The root, because of the essential oil it contains, is undoubtedly an insecticide and for that reason is used as a protective of shawls and other woollen fabric. The drug has also been extolled for its beneficial effect against leprosy, but Dr. Muir in charge of the Leprosy Research tested both the powdered root as well as the essential oil in a number of patients without any benefit.

Summary :—*Saussurea lappa* or kut root grows on the moist slopes of the Northern Himalayas at a height of 8,000 to 13,000 feet above the sea level. The chief active constituents of the root are :—(*i*) An essential oil 1.5 per cent., (*ii*) an alkaloid which has been named saussurine 0.05 per cent., (*iii*) resin 6.0 per cent. Besides these, there occur a large amount of inulin, traces of a bitter substance, small quantities of tannins, potassium nitrate, sugars, etc. The leaves contain no essential oil but 0.025 per cent. of the alkaloid saussurine. The essential oil has a strong aromatic penetrating and fragrant odour. It has antiseptic and disinfectant properties ; it relaxes the involuntary muscle tissue and it is a cardiac stimulant, a carminative, an expectorant and a diuretic. The alkaloid saussurine has a depressant action on the vagus centre in the medulla as well as on the involuntary muscle fibres of the bronchioles and gastro-intestinal tract. It produces a slight but persistent rise of blood pressure and increases the force of contraction and amplitude of the ventricles. The drug has a remarkable effect in controlling attacks of bronchial asthma, especially those of the vagotonic type. The paroxysms are cut short by the combined action of the essential oil and the alkaloid present in the root. The essential oil during its ex-

cretion in the lungs not only relaxes the bronchial muscle but has a marked expectorant action which relieves turgescence of the mucosa. It may be pointed out, however, that although the drug relieves asthmatic attacks, it does not produce a permanent cure unless the causal factors are investigated and removed. The drug is also useful in persistent hiccough. The drug has no anthelmintic action, nor has it any action against malaria, leprosy and rheumatism as has been claimed by writers of the indigenous systems in this country.

References :—

(1) Acton, H. W., and Chopra, R. N., 1923, *Ind. Med. Gaz.*, Vol. LVIII, p. 363; (2) Chopra, R. N., and De, P., 1924, *Ind. Med. Gaz.*, Vol. LIX, p. 540; (3) Chopra, R. N., 1928, *Ind. Med. Gaz.*, Vol. LXIII, p. 186; (4) Ghosh, S., Chatterjee, N. R., and Dutt, A. T., 1929, *Jour. Ind. Chem. Soc.*, Vol. VI, p. 517; (5) Chopra, R. N., and De, P., 1929, *Ind. Jour. Med. Res.*, Vol. XVII, p. 351.

SEMECARPUS ANACARDIUM (N.O. Anacardiaceæ)

The Marking-nut tree

VERN.—Sans.—*Bhallatamu* ; Hind.—*Bhilawa, Bhela* ; Beng.—*Bhela, Bhelatuki* ; Punj.—*Bhilawa, Bhela* ; Bomb.—*Biba, Bhiba* ; Tam.—*Shay-rang, Shen-kottai* ; Tel.—*Jidi Chettu* ; Pers.—*Biladur.*

It is a deciduous tree of the Sub-Himalayan tract from the Sutlej eastward, ascending to an altitude of 3,500 ft. and is found throughout the hotter parts of India as far east as Assam. The tree yields an acrid viscid juice from which a varnish is made. The pericarp of the fruit contains a bitter and powerful astringent principle, which is universally used in India as a substitute for marking ink. The juice of the pericarp of the nut is used in indigenous medicine in small doses both externally and internally. Externally, it it a powerful counter-irritant and a vesicant and has been employed as a local application in rheumatism, sprains and leprotic nodules. Its powerful irritant properties have frequently been made use

of by malingerers in producing opthalmia and skin lesions and also in procuring abortions. Internally, the juice mixed with some bland oil is used in syphilis, scrofulous affections, dyspepsia, piles and nervous debility.

Chemical Composition :—Very little systematic work was done with regard to the chemical composition of this drug till recently. It was suggested by earlier investigators that the black corrosive juice of the pericarp contained a tarry oil consisting of 90 per cent. of an oxy-acid named anacardic acid and 10 per cent. of a higher, non-volatile alcohol called cardol. Naidu (1925) isolated catechol and a mono-hydroxyphenol which he called 'anacardol', besides two acids and a fixed oil from the kernel of the nut. Recently, Pillay and Siddiqui (1931) have studied the composition of the drug. They were unable to find either anacardic acid and cardol or catechol and anacardol as reported by previous investigators. They have succeeded in isolating the following constituents from the juice of the pericarp:—

(1) A monohydroxyphenol, which forms 0.1 per cent. of the extract. This has been named 'semecarpol' (B. P. 185-90°); congealing below 25° to a fatty mass.

(2) An o-dihydroxy compound forming 46 per cent. of the extract (15 per cent. of the nut). This has been called 'bhilawanol' (this distils at 225-26° and congeals below 5°).

(3) A tarry, non-volatile corrosive residue forming about 18 per cent. of the nut.

Pharmacological Action and Therapeutic uses :—No work of recent date has been done to find out the nature of the action of the active principles occurring in the drug. Its use as a therapeutic agent even in the indigenous systems of medicine has dwindled to a great extent owing to the fact that the irritation produced by its application cannot be properly controlled and, more often than not, it over-shoots the desired mark. Further study is necessary before it can be usefully employed in medicine.

References :—

(1) Naidu, 1925, *Jour. Ind. Inst. Sci.*, Vol. VIII A, p. 129; (2) Pillay and Siddiqui, 1931, *Jour. Ind. Chem. Soc.*, Vol. VIII, p. 517.

SIDA CORDIFOLIA (N.O. Malvaceæ)

VERN.—Sans.—*Bala, Batyalaka ;* Hind.—*Kungyi, Khareti, Bariar ;* Beng.—*Brela, Bala ;* Mar.—*Chikana ;* Punj.—*Simak ;* Tel.—*Muttava, Chiribendu.*

Sida cordifolia or 'bala' is considered to be one of the most valuable drugs in the Ayurvedic or Hindu medicine and has been largely used by the Hindu physicians from very ancient times. In the Tibbi or the Mohammedan medicine it was used for its aphrodisiac effects. A systematic study of the chemical composition and medicinal properties was made by the Departments of Pharmacology and Chemistry of the Calcutta School of Tropical Medicine.

The genus Sida belongs to the natural order Malvaceæ and the plants belonging to this group are known in Sanskrit by the general name 'bala'. There are some seven or eight species but Sanskrit writers make mention of five species of 'bala' under the name 'pancha bala'.

1. Bala—*Sida cordifolia*, Linn. (Fl. Br. Ind., I, 324; Fl. Ind., 517), 'brela'.
2. Mahabala—*Sida rhombifolia*, var. *rhomboidea*, Roxb. (Fl. Br. Ind., I, 324; Fl. Ind., 517).
3. Nagbala—*Sida spinosa*, Linn., syn. *S. alba* and *alnifolia*, Linn. (Fl. Ind., 516) ; 'pila' or 'peet berela', 'bon methi' (Beng.).
4. Atibala—*Sida rhombifolia*, Linn. (Fl. Br. Ind., I, 323) ; 'lal barila' or 'berela'.
5. Bala Phanijivika—*Sida caprinifolia*, Linn. syn. *S. acuta*, Burn. and *S. lanceolata*, Roxb. (Fl. Br. Ind., I, 323) ; 'pila' or 'peet berela'.

There is another species known to the Sanskrit writers as 'bhumibala'—*Sida humilis, Willd.* (Fl. Br. Ind., I, 322, Roxb. 516), or *Sida veronicifolia.*

Sida cordifolia, Linn., also known as *S. herbacea*, Micans, and *Rotundifolia*, Cav.; *S. althæifolia*, Swartzs, known in English as country mallow, is a small herb which grows throughout the plains of India where the climate is damp. The seeds are called 'bijband'.

It is distributed throughout tropical and sub-tropical India and Ceylon growing wild along the roadside in the villages. It is a perennial undershrub with long branches, rooting at the nodes with scattered stellate hairs. The leaves are cordate, oblong, obtuse, crenate and very downy on both surfaces. The petioles are as large

as the leaf, the stipules are linear measuring nearly half the length of the petiole. The peduncles occur near the flower, the lower one is distant and is longer than the petioles, and the upper one is very short. The flowers are small and white and appear during the rainy season in all species. The roots of the different species of Sida are 2 to 5 inches long, about ¼ inch in diameter and the stock is woody and fibrous. The bark is of a light yellowish-brown colour. If properly cultivated, the plant may grow as big as hemp or jute plant and produces a strong fibre.

Uses in the Indigenous Medicine:—The roots, leaves and seeds are all used in medicine and have a slightly bitterish taste. *The roots of all the species are regarded as cooling*, astringent, stomachic and tonic. An infusion made from them is given in nervous and urinary diseases and also in disorders of the blood and bile. They are considered aromatic bitters having febrifuge, demulcent and diuretic properties. The seeds are considered to be aphrodisiac and are used in gonorrhœa, cystitis and are also given for colic and tenesmus. The leaves are used in ophthalmia. The root juice is used for healing wounds; the juice of the whole plant is also used in rheumatism and spermatorrhœa. Made into a paste with juice of palmyra tree it is applied locally in elephantiasis. A decoction of the root and ginger is given in intermittent and other fevers attended with shivering fits. The root-bark powder is given with milk and sugar in persons suffering from frequent micturition and leucorrhœa. In many nervous diseases, *e.g.*, hemiplegia, facial paralysis, headache, etc., the root is used either by itself or in combination with asafœtida and rock salt. It is also given internally and an oil called 'bala-táila' prepared from a strong decoction of the drug mixed with milk and sesame oil is used as external application. Mixed with 'makaradhwaja' and musk it is used as a cardiac tonic.

Besides the above medicinal properties, the plant is of great commercial value as it yields a fine white fibre, the cellulose content of which is 83 per cent. as against 75 per cent. in jute. In the opinion of many experts no fibre of modern times affords better hopes of success than Sida as a substitute for flax.

Chemical Composition:—*Sida cordifolia* was analysed many years ago (1890) and was said to contain asparagin. A perusal of the litera-

ture shows that no detailed or systematic study of the nature of the chemical constituents present in the plant has been carried out. The drug was analysed by Ghosh and Dutt (1930) and the following is a summary of the work :—

A preliminary examination showed the presence of alkaloids and a quantitative estimation showed their occurrence to the extent of 0.085 per cent. of the whole plant as an average of 5 analyses. The seeds were found to contain about 4 times more alkaloid than either the stems, roots or leaves.

A systematic examination of the drug by extraction with different solvents showed the presence of the following :—(1) fatty oil, phytosterol, mucins, potassium nitrate, resins, resin acids, etc., but no tannin or glucoside, (2) alkaloids to the extent of 0.085 per cent. The hydrochloride of the alkaloid occurs in colourless needles and is freely soluble in water but sparingly soluble in absolute alcohol. The main portion of the alkaloid was identified to be *ephedrine,* an alkaloid so far observed in the different varieties of Ephedra only. These two plants belong to entirely different divisions of the vegetable kingdom. The ephedras belong to the groups of Gymnosperms while *Sida cordifolia* belongs to Angiosperms.

Pharmacological Action :—As the action of the ephedrine is well-known it is unnecessary to describe it here. It may be stated that it was owing to the close resemblance of the pharmacological action of the Sida alkaloid to ephedrine that suspicions were aroused that it may be the same alkaloid. This was confirmed later by chemical studies. Its use as a cardiac stimulant in the old Hindu medicine has thus a natural basis.

Therapeutic Uses :—The plant generally met with contains only small quantities of ephedrine, 0.085 per cent. in the whole plant and over 0.3 per cent. in the seeds. It is quite possible that by proper cultivation and collection the alkaloidal content could be increased. As the plant grows abundantly in the plains of India this may give an easily-obtainable crude material for manufacture of ephedrine. The ephedras generally grow in India in the hills, often difficult from point of view of transport, and for this reason the price of this useful alkaloid is very high. Further work on these lines is in progress.

References :—

(1) Chopra, R. N., and De, P., 1930, *Ind. Jour. Med. Res.*, Vol. XVIII, p. 467 ; (2) Ghosh, S., and Dutt, A., 1930, *Jour. Ind. Chem. Soc.*, Vol. VII, p. 825.

SYMPLOCOS RACEMOSA (N.O. Styraceæ)

The Lodh tree

VERN.—Sans.—*Lodhra* ; Hind.—*Lodh*, *Tilak* ; Beng.—*Lodh* ; Mar.—*Lodhra* ; Guj.—*Lodhar* ; Tel.—*Ludduga*.

It is a small tree found very commonly in the plains and lower hills of Bengal, Assam and Burma. It is also found in the dry forests of the Chota Nagpur plateau up to an altitude of about 2,500 ft. above the sea level. The bark and leaves of this species are used in dyeing and a yellow dye is said to be extracted from both. In medicine the bark is chiefly used, and according to U. C. Dutt, it is a very good astringent and is useful in bowel complaints, eye diseases and ulcers. A decoction of the bark is used even to this day in villages as a gargle in spongy and bleeding gums. In Bombay the bark is often employed in the preparation of plasters and is supposed to promote resolution of inflammatory masses and exudates.

Chemical Composition :—Hesse (1878) obtained from the bark three alkaloids (1) *loturine* 0.24 per cent., (2) *colloturine* 0.02 per cent. and (3) *loturidine* 0.06 per cent. Besides this, a large quantity of red colouring matter was also obtained. Later on, Späth showed that loturine was identical with abrine and harman.

Therapeutic Uses :—Alcoholic extracts and watery extracts of 'lodh' are very frequently used by the medical profession as astringents for looseness of the bowels. The bark-powder, in 20 grain doses thrice daily, has also been used in combination with 'bael' and 'kurchi' bark. In cases of chyluria and elephantiasis due to filarial infections, 'lodh' has been for sometime past a favourite remedy with many physicians in this country. No definite statement with regard to its utility in medicine can be made unless further clinical and laboratory trials are carried out. At present its use is purely empirical.

References :—

(1) Hesse, 1878, *Ber.*, Vol. II, p. 1542; (2) Späth, 1920, *Monatsh. Chem.*, Vol. 41, p. 401.

TARAKTOGENOS KURZII (N.O. Bixineæ)

VERN.—Hind. & Bomb.—*Chaulmoogra* ; Mar.—*Kadu-kvatha* ; Tam.—*Niradimutu.*

HYDNOCARPUS WIGHTIANA (N.O. Bixineæ)

VERN.—Dec.—*Jangli-badam* (seeds) ; Bomb.—*Kowti, Kava* ; Mar.—*Kowti, Kadukavata* ; Tam.—*Yetti, Maravetti* ; Tel.—*Niradi-vittulu* (seeds).

Chaulmoogra has been used in the Hindu medicine against leprosy for many centuries and during recent years it has come to be recognised in the Western medicine as a most valuable remedy in the treatment of this disease. In the Buddhistic literature of ten or more centuries ago, mention is made of the great improvement 'in the condition of the lepers after eating raw chaulmoogra seeds. There are records to show that the oil extracted from the seeds has been used in the treatment of leprosy and as a household remedy for many skin diseases since 1595. In the 'Makhzan-el-Adwiya,' one of the oldest books on Mohammedan materia medica, mention is made of the use of the seeds under the name of 'chaulmoogri'.

In the indigenous medicine the oil was orally administered mixed with clarified butter, the resultant mixture having a brownish yellow colour and the consistence of a soft ointment. The Western practitioners quickly appreciated the beneficial effects produced by this drug and began to use it in the very early days of British rule. In 1854, Mouat reported improvement in a case of leprosy as a result of oral administration and local application of chaulmoogra. In 1868, the curative effects of chaulmoogra were so well-known that it was made official in the *Pharmacopœia of India*, the chief preparation being an ointment which was directed to be made from the pounded kernels mixed with 'unguentum simplex'. It was not till 1904, when Fredrick B. Power and his collaborators published in

detail the chemistry of chaulmoogra oil, that the attention of the scientific world was drawn to this valuable drug.

The oil is obtained from *Taraktogenos kurzii*, which is a tall, evergreen tree 40 to 50 feet in height with lanceolate or oblong lanceolate leaves 7 to 10 inches in length. It grows in abundance in Eastern Bengal and the upper part of Burma and is distributed along the eastern and southern slopes of the Pegu, Yoma, Martaban, in the forests of Sylhet, Chittagong, etc. The fruits, which grow upon the stems and main branches of the tree are of the size of an orange and have numerous seeds embedded in the pulp. The oil is expressed from these seeds. The hill tribes in Sikkim use the pulp to poison fish and sometimes use it as a food also after boiling it with water. The bark of the tree is said to be used as a febrifuge; it contains large amounts of tannin and an infusion made from it has the odour of the essential oil of bitter almonds.

Besides *Taraktogenos kurzii*, certain other trees belonging to the natural order Bixineæ also yield oils having a composition closely akin to that of true chaulmoogra oil. *Hydnocarpus wightiana* is one of the most important members of this group. It grows abundantly in the western parts of the Peninsula from South Konkan along the coastal range. It is known by the name of 'kowti' in those parts and is a tall tree having a whitish wood. The fruit is globose, about the size of an apple, with a rough thick brown rind. Within the fruit there are from ten to twenty obtusely-angular seeds, ¾ inch in length embedded in a scanty white pulp firmly adherent to the thin black testa. When the pulp is peeled off, the outer surface of the testa is seen to be rough and striated by shallow longitudinal grooves. Inside the shell is a copious oily albumen, containing two large, plain, heart-shaped, leafy, cotyledons like those of chaulmoogra. The albumen when fresh is white but turns to a dark brown colour in the dry seeds; the odour resembles that of chaulmoogra.

Hydnocarpus anthelmintica is another member of the same family. This tree is indigenous to Siam, Northern Cochin and Gamboja. The seeds about 30 to 40 in number, are found in pods, which differ from chaulmoogra only in having a

stronger testa. The seeds were exported to China from Siam under the name of 'dakrabo'. Recently, the native Chinese tree 'ta-feng-tzu' has been identified as *Hydnocarpus anthelmintica.* This tree grows extensively all over China and the fruits can be bought cheaply and plentifully at the wholesale drug fairs. Though its identity has only been recently discovered, it is interesting to note that the seeds are described in Chinese books, *e.g.*, *Pen t'sas* (1590) as good for leprosy, itch, pityriasis, psoriasis, syphilis, lipoma, etc. There are several other species which have also been recognised as important sources of the oil. In the following table, the names of the most important members with their habitat are given.

Description		Habitat
Hydnocarpus venenata	...	Ceylon, Deccan and Burma
,, *castanea*	...	Burma
,, *anthelmintica*	...	Siam, French Indo-China
,, *curtisii*	...	Penang
,, *hutchinsonii*	...	Philippine Islands
,, *subfalcata*	...	,, ,,
,, *woodii*	...	India
,, *alpina*	...	
Asteriostigma macrocarpa	...	Travancore
Oncheba echinata	...	Sierra Leone
Carpotroche brasiliensis	...	South America

In the older literature, it was believed that chaulmoogra oil was derived from the seeds of *Gynocardia odorata.* It was not till 1901 that Prain showed that true chaulmoogra oil was obtained from the seeds of *Taraktogenos kurzii,* a tree grown in Assam and Burma.

Gynocardia odorata is a native of Sikkim, Assam, and Chittagong in East Bengal. In Assam, an oil is sometimes expressed from it by the local people. The fruits as well as the seeds are very similar in appearance to those of *Taraktogenos kurzii* and that is probably the reason for the confusion that existed for such a long time. The seeds of *Taraktogenos kurzii* may, however, be distinguished by the fact that the radicle of the seed is terminal, while in Gynocardia seed it is lateral.

The chief sources of oil in India are *Hydnocarpus wightiana* and *Taraktogenos kurzii*. *Hydnocarpus wightiana* grows over gardens and accessible places all over South India, so that seeds can be obtained quite fresh. *Taraktogenos kurzii*, on the other hand, grows in out of the way places where its seeds cannot be gathered easily during the rainy season when the fruit falls, and in consequence, it is not easy to get fresh seeds for extraction of the oil. The oil derived from *Hydnocarpus wightiana* is, therefore, preferred to the other. Hydnocarpus oil is further considered to be superior on account of its higher rotation value (5.5 degrees higher than chaulmoogra oil).

Chemical Composition :—Chaulmoogra oil is liquid at ordinary temperature and is of a pale yellow to a reddish brown colour with a somewhat acrid taste. The oil sold in the bazar is usually rancid and dark brown and devoid of therapeutic properties as it is usually expressed from old seeds. The seeds yield 30 to 40 per cent. of the oil according to the method of extraction used; by hydraulic pressure only 30.9 per cent. is obtained but by ether extraction method the quantity is increased to 38.1 per cent. The fatty oil obtained thereby has the following properties :—

	Expressed Oil	Oil extracted by ether
Melting point	22—23°C	22—23°C
Sp. gravity	0.951 at 25°C	0.952 at 25°C
Acid value	23.9	9.5
Saponification value ...	213.0	208.0
Iodine value	103.2	104.4
Specific rotation ...	+52.0°	+51.3°

Power and his associates (1904) worked out the chemistry of chaulmoogra oil very exhaustively. They found that the oil consists chiefly of the glyceryl esters of two or more new fatty acids. The new acids isolated differ from any previously known fatty acids in containing a five-membered carbon ring with side chains of diminishing length as the molecular weight decreases. Further, these acids are unique in being optically active and dextro-rotatory. They contain only one pair of doubly-linked carbon atoms, hence they absorb but two halogen atoms. These acids were named 'chaulmoogric' and 'hydnocarpic' acids by the discoverers and it is probable that the specific bactericidal and medicinal properties of these acids are associated in some way with their molecular constitution. The constitutional formula is given below :—

Hydnocarpic acid $C_{16}H_{28}O_2$

```
   CH
  //  \
CH     CH(CH2)10COOH
|      |
CH2----CH2
```

Chaulmoogric acid $C_{18}H_{32}O_2$

```
   CH
  //  \
CH     CH(CH2)12COOH
|      |
CH2----CH2
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Besides the above mentioned acids, chaulmoogra oil contains a small amount of palmitic acid and, as Wrenshall and Dean (1924) have found, another highly unsaturated acid with an iodine number of 168.3.

The oil expressed from the fresh seeds of *Gynocardia odorata* was shown by Power and Barrowcliff (1905) to differ completely from chaulmoogra oil, both in its physical character and in its chemical composition. Gynocardia oil at ordinary temperatures is a pale yellow liquid having an odour resembling that of linseed oil. It is completely devoid of optical activity and contains the following constituents :—(1) linolic acid or isomerides of the same series, (2) palmitic acid in considerable amount, (3) linolenic and iso-linolenic acids, (4) oleic acid, (5) crystalline cyanogenetic glucoside, gynocardin. The specific unsaturated acids on which the action of chaulmoogra oil depends are not present in the Gynocardia oil.

In the table on page 396, the characteristics of chaulmoogra and allied oils are given for comparative study.

Pharmacological Action :—Chaulmoogra oil itself has very little bactericidal property as it cannot easily penetrate the bacterial cell-wall. It possesses, however, a definite bacteriostatic action as is evidenced by the fact that addition of the oil (2 per cent.) to culture media inhibits the growth of acid-fast bacilli, such as tubercle bacilli. Derivatives of the oil, on the other hand, are more active. Sodium salts of the total fatty acids—chaulmoogrates—are said to possess a high degree of bactericidal and bacteriostatic activity against tubercle bacillus *in vitro* in such dilutions as 1 in 100,000. This action is said to be a specific one as it is not present in the case of such closely related fatty acids as those occurring in cod-liver oil, etc. Suspensions of virulent tubercle bacilli are said to be rendered harmless to guinea pigs by incubation for 48 hours with any of the acid sodium salts or the esters of the fatty acids of chaulmoogra oil. The esters are found to have no inhibitory effect on *Staphylococcus albus* and other allied organisms.

*TABLE

	Specific gravity, $\frac{30°C}{30°C}$	Refractive index $n\frac{30}{D}$	Freezing point °C	Rotation 100 mm. 30°/D	Iodine number hanus	Saponification number	Fatty acid specific rotatory power $[\alpha]\frac{30}{D}$
Gynocardia odorata ...	0·929	1·4743	4	0	160	198	0
Hydnocarpus alcalæ ..	0·948	1·4763	24	48·3	94·0	202	40
Hydnocarpus anthelmintica .	0·952	1·4630	16	44·2	84·5	201	50
Hydnocarpus venenata ...	0·947	1·4769	20	46·4	90·7	191	49
Hydnocarpus wightiana ..	0·947	1·4763	11	51·2	97·0	207	54
Taraktogenos kurzii ...	0·951	1·4771	9	43·5	104	215	43
Asteriostigma macrocarpa ..	0·955	...	...	48·1	95·2	198	...

* Modified from Perkins and Cruz, 1923.

Chaulmoogra oil is extremely irritating by whichever route it is administered. Oral administration of 3 to 4 drops of the oil produces nausea and vomiting, but it is possible to develop a tolerance to it so that as much as 15 minims can be taken in a single dose. Not only the oil, but the sodium salts of the fatty acids as well as the esters have powerful irritant actions as well. The injection of these medicines into the tissues is painful and local abscesses may form. The systemic effects produced by chaulmoogra oil derivatives are not very marked.

THERAPEUTIC USES :—*Administration of Chaulmoogra Seeds and Oil by the Oral Route.*—Chaulmoogra has long been used in India in certain skin diseases and particularly against leprotic lesions of the skin. Originally chaulmoogra seeds were given by the mouth, but this was found to be unsatisfactory and so the oil expressed from the seeds began to be used. Oral administration, of both the seeds and the oil produces nausea and vomiting and cannot be continued for a long time. It was, therefore, largely discarded in favour of the intramuscular and intravenous administration of the drug. Recently, however, oral administration has again been advocated by some physicians, particularly for those cases of leprosy which cannot attend the treatment centres regularly. Attempts have been made, therefore, to overcome the irritant action of the oil on the stomach by giving it in keratin-coated capsules, or as suggested by Denny (1929) by the addition of benzocaine. Travers (1926) in the Federated Malay States, has revived the old Chinese treatment which consists in giving 2 parts of the powdered whole nut of *Hydnocarpus anthelmintica* with 1 part of *Cannabis indica.* Wayson and Badger (1928) employed a preparation of the esters which can be given without inconvenience by the mouth. While it cannot be denied, in the light of the investigations carried out by de Aguiar Pupo (1926), Rodriguez (1925) and Lindow (1927), that the oral administration of chaulmoogra is definitely beneficial, it must be realised that it is very difficult to administer it in sufficiently large doses by this route and that a prolonged

course of treatment which is essential for success is in many cases impossible.

Chaulmoogra Oil and Ethyl Esters by the Intramuscular Route:—The next important step in the treatment was the administration of chaulmoogra oil by the intramuscular route. As the oil itself is very irritant, Mercado (1914) tried to produce a preparation which would prove less irritant to the tissues. He used a mixture of 60 c.c. of chaulmoogra oil, 60 c.c. of camphorated oil to deaden the pain and 4 gm. of resorcin as an antiseptic. Heiser (1914) treated a small series of cases with this mixture and reported 11.1 per cent. of apparent cures. This treatment has now been largely abandoned as patients refuse to submit to it on account of the pain it produces at the site of injection. In 1919, Dean prepared the ethyl esters of the total fatty acids of chaulmoogra. It is also evident from the Report of the Leprosy Conference held in Calcutta in 1920 that in India, Sudhamoy Ghosh (independently of Dean) prepared the ethyl ester and suggested its use to Rogers. The injection of the ester of the pure acid, however, proved somewhat irritating to the tissues of the body and Rogers discontinued its use for some time. McDonald (1920) was, however, more successful and treated a number of cases with the ethyl esters of the entire fatty acids of the whole oil with 2 per cent. iodine by weight, chemically combined. The results which followed this method were very satisfactory and were unattended by pain and abscess formations. In India, Muir has largely used the ethyl esters. He has employed the following formula which has now become famous as the E. C. C. O. mixture:—Mixed ethyl esters 30 c.c., pure creosote 30 c.c., camphor 30 gms. and olive oil 75 c.c. He prepares the esters in the following manner:—

(1) *Hot Process*:— 425 gm. of crude cold-drawn hydnocarpus oil, 552 c.c. of 96 per cent. ethyl alcohol and 31.87 c.c. of sulphuric acid (sp. gr. 1.845) are placed in a 2½ litre flask fitted with a reflux condenser; the alcohol and oil are mixed before the acid is added. The contents are allowed to boil on a water bath for 24 hours without intermission. The reaction product is then transferred to a separating funnel and washed with water and then with 0.2 per cent. sodium

carbonate solution; crystals of sodium chloride are then added gradually when the emulsion breaks up and esters rise to the surface.

(2) *Cold Process* :—This takes longer than the hot process, but has the advantage that no special apparatus is required and the labour is less. The oil, alcohol and the acid are mixed in the same proportions as in the hot process in a 4 lbs. bottle with a tightly-fitting glass stopper and left until the process of esterification is complete. The bottle is shaken once or twice a day to mix up the upper with the lower layers and is kept in some warm place. It takes 2 to 3 weeks for the process to be completed. This method can be used in any ordinary leper institution. The weight of esters formed is almost equal to the weight of oil used.

The treatment with ethyl esters has now become very popular and his constituted the chief medicament in use in many leper institutions. It has been used to a considerable extent in China by Fowler (1922), Wilson (1924), Read and Feng (1925) and others. Some workers have preferred to add 25 per cent. of camphor to the mixture. A number of preparations of the ethyl esters are available in the market, the best known of, these preparations being, 'moogrol' (British), 'antileprol' (German) 'antilebrine' (Italian).

Sodium Salts of the Fatty Acids of Chaulmoogra and Hydnocarpus Oils :—Rogers (1916) prepared the sodium salts of the fatty acids of chaulmoogra oil. These sodium salts were found to be freely soluble in water and their toxicity was also low so that they could be injected intravenously without any danger to the patients. Later, it was observed that salts of higher-melting fatty acids are more irritant and painful and Rogers attempting to do away with this drawback, advocated the use of the less irritating lower-melting fatty acids of the oil. 'Alepol' is a salt prepared froni such an acid. This salt has also been held in high esteem by many leprosy experts.

Dikshit (1932) has studied the pharmacological action of this drug. Its toxicity is fairly low. A 3 per cent. solution introduced into the femoral vein of cats or dogs is lethal in doses of about 0.3 gm. per kilo of body weight. It has a selective action on acid-fast bacteria and inhibits the growth of tubercle bacilli in concentrations as low as 1 in 200,000. It also exerts a toxic action on some helminths like

the microfilaria of crows and tapeworms of cats. It has got a slight depressant action on the cardio-vascular system. Respiration is stimulated by small doses administered intravenously and the bronchioles are slightly dilated. The most important action is, however, on the erythrocytes. The soap has got marked hæmolytic properties, but this action can be considerably lessened by dissolving the drug in Locke's solution and using Muir's expedient for giving intravenous injections. The latter consists in withdrawing blood in the syringe containing the dose, mixing and then injecting the whole quantity intravenously. This reduces the local action on the vessel endothelium and also diminishes the hæmolytic action of the soap on the red blood cells.

From a study of the different methods of treatment, it is evident that chaulmoogra oil is really effective in the treatment of leprosy. The modern methods of treatment by employing the ethyl esters or sodium salts of the fatty acids appear to be distinctly better than the ordinary administration of the oil by the oral or the intramuscular route, though the latter methods are not devoid of therapeutic activity. The oil obtained on the market is very frequently mixed with gynocardia oil and linseed oil. Much of the discrepancy in the results obtained by various workers in the treatment of leprosy in the early periods can probably be accounted for by the badly adulterated oils they had to use. Chaulmoogra oil is costly and even now when large supplies are available there is great temptation for the retail dealers to mix cheaper oils with it. Owing to the extended use of the hydnocarpus oil at the present time, a good quality of the oil is now available on the market. Whenever there is any doubt as to the nature of the oil, it is always better to test its purity. Of all the tests, the specific rotation of polarised light is probably the best indication. The specific rotation of the oil from *Hydnocarpus wightiana* is 57.7° and that from *Hydnocarpus anthelmintica* 52.5°.

References :—

(1) Power and Gornall, 1904, *Jour. Chem. Soc.*, pp. 838, 851; (2) Power and Barrowcliff, 1905, *Jour. Chem. Soc.*, pp. 884, 896; (3) Heiser, V. G., 1914, *Am. Jour. Trop. Dis.*, II, 300; (4) Lara, C. B.,

1928, *J. Philippine Islands Med. Assn.*, VIII, 56; (5) Lindow, E. D., 1927, *Report on the Straits Settlements Leper Asylums for 1926;* (6) McDonald, J. T., 1920, *Jour. Am. Med. Assn.*, LXXV, 1483, (7) McDonald, J. T., and Dean, A. L., 1921, *Jour. Am. Med. Assn.*, LXXVI, 1470; (8) Report of Leprosy Conference at Calcutta, 1920; (9) Muir, E., 1921, *Handbook on Leprosy*, Calcutta; (10) Pupo, J. De Aguiar, 1926, *Brazil Med.*, XL, 69, 85; (11) Read, B. E., 1925, *China Med. Jour.*, XXXIX, 619; (12) Read, B. E., and Feng., C. T., 1925, *China Med. Jour.*, XXXIX, 612; (13) Rodriguez, J., 1925, *Trans. 6th Congress Far Eastern Assn. Trop. Med.*, II, 716; (14) Rogers, L., *Lancet*, 1916, i, 288; 1921, i, 1178; (15) Rogers, L., 1927, *Proc. Roy. Soc. Med.*, XX, 1021; (16) Travers, E. A. O. 1926, *Proc. Roy. Soc. Med.*, XIX (Section Trop. Dis. and Hyg.), 1; (17) Wayson, N. E., and Badger, L. F., 1928, *U. S. Publ. Health Rep.*, XLIII, 2883; (18) Wilson, R. M., 1924, *China Med. Jour.*, XXXVIII, 743; (19) Dikshit, B. B., 1932, *Ind. Jour. Med. Res.*, Vol. XIX, p. 775.

TERMINALIA ARJUNA (N.O. Combretaceæ)

Arjuna

VERN.—Sans.—*Arjuna, Kukubha* ; Hind.—*Arjun, Kahu* ; Beng.—*Arjun* ; Bomb.—*Arjuna* ; Tam.—*Vellai-maruda-maram.*

Terminalia arjuna is a large deciduous tree attaining a height of 60 to 80 feet. It is common throughout the Sub-Himalayan tracts of the United Provinces and in the Deccan, Southern Bihar, Chota Nagpur, Burma and Ceylon. The bark is considered by the Sanskrit writers to be a cardiac tonic. Vagbhatta was the first to prescribe the bark of 'arjuna' in heart disease. Later, Chakradatta the great Hindu physician, described it as a tonic and astringent, and used it in heart disease. He recommended it to be given as a decoction with milk and treacle water or as a 'ghrita' (preparation with ghee or melted butter) made with the decoction or powder of the bark.

The bark and preparations made from it are reputed to have a marked stimulant action on the heart even to the present day in this country. The practitioners of Hindu medicine use them for all sorts of conditions of cardiac failure and dropsy. Some of the practitioners of Western medicine believe in its stimulant effect on the heart and use it as a cardiac tonic. A

liquid extract prepared from the bark is on the market in Calcutta.

Chemical Composition:—A reference to the literature shows that this drug has interested many previous investigators. According to Hooper (1891) the bark yields 34 per cent. of ash consisting almost entirely of pure calcium carbonate; the watery extract contains as much as 23 per cent. of calcium salts and 16 per cent. of tannins. Very little colouring matter besides the tannin is extracted by alcohol. Ghoshal (1909) made a detailed chemical and pharmacological study of the bark. He found it to contain the following substances:—(1) sugar, (2) tannin, (3) colouring matter, (4) a body of the nature of a glucoside and (5) carbonates of calcium and sodium and traces of chlorides of alkali metals. He also found that the total tannin content amounted to 12 per cent. and the content of ash to 30 per cent. The author and his co-workers obtained good specimens of the bark and made a careful analysis with a view to finding out the active principles which might be responsible for the alleged stimulant action of the drug on the heart. As the drug is said to contain glucosides, a very careful search was made for their presence. Neither alkaloid nor glucoside could be found in the bark and there was no substance of the nature of an essential oil. The bark contains the following substances:—

(1) Unusually large quantities of calcium salts with small amounts of aluminium and magnesium salts.

(2) About 12 per cent. of tannins, consisting mainly of pyrocatechol tannins.

(3) An organic acid with a high melting point and a phytosterol.

(4) An organic ester easily hydrolysed by mineral acids.

(5) Some colouring matters, sugars, etc.

It will be seen that the analysis of the bark of *Terminalia arjuna* does not reveal the presence of active principles which could account for its cardiac-tonic effects so widely believed in in this country. The different fractions obtained from petroleum ether, alcoholic and aqueous extracts during analysis were carefully tested but, with the exception of calcium compounds, no other constituent producing any effect on the heart or on any of the other tissues were detected. The colouring matter was separated and tested with the same result. Recently, Caius, Mhaskar and Isaac (1930) have studied in detail the chemical composition of the common Indian species of the genus Terminalia. They were unable to find any active constituent of the nature of an alkaloid or glucoside or an essential oil. All the fifteen specimens of barks examined gave when incinerated a white, soft, odourless and tasteless ash. Except for the presence of iron in *T. pyrifolia* and *T. travancorensis* the composition of the ash is fairly constant. The mineral constituents of the barks of the different species of Terminalia are given below in tabular form:—

TABLE

Showing Mineral Constituents per cent. of Bark of the Terminaliae

	CaO	CO_2	MgO	P_2O_5	SO_3	Cl	K_2O	Na_2O	Fe_2O_3	SiO_2
1. T. arjuna	14·995	10·602	0·280	1·065	0·119	0·220	1·017	...	...	0·051
2. T. bialata	14·861	10·256	0·273	1·093	0·102	0·043	0·346	...	...	0·080
3. T. belerica	14·046	10·242	0·782	1·218	0·124	0·835	0·789	0·485	..	0·158
4. T. tomentosa ...	12·012	8·253	0·484	0·953	0·061	0·286	0·256	...	..	0·089
5. T. manii	11·823	7·927	0·494	0·923	0·112	0·091	0·256	...	...	0·076
6. T. myriocarpa ...	10·363	8·671	0·226	0·702	0·081	0·036	0·354	0·218	...	0·058
7. T. chebula ...	10·244	8·302	0·557	0·870	0·058	0·188	0·425	...	...	0·366
8. T. catappa ...	7·511	5·579	0·501	0·854	0·340	0·492	0·587	0·364	...	0·031
9. T. travancorensis ...	7·062	4·930	0·332	0·627	0·068	0·043	0·194	...	0·003	0·107
10. T. pyrifolia .	6·741	4·843	0·313	0·632	0·069	0·029	0·210	...	0·042	0·132
11. T. oliveri	6·663	4·389	0·265	0·519	0·018	0·008	0·022	...	..	0·011
12. T. pallida	5·589	3·636	0·434	0·391	0·139	0·017	0·282	..	..	0·080
13. T. citrina	5·147	3·635	0·089	0·023	0·069	0·016	0·127	...	.	0·047
14. T. coriacea ..	4·666	2·953	0·190	0·447	0·171	0·040	0·066	...	...	0·021
15 T. paniculata ...	4·427	2·806	0·213	0·459	0·146	0·019	0·073		...	0·078

Therapeutic Uses :—Koman (1919-20) administered a decoction of the bark in 20 cases of valvular diseases of the heart and came to the conclusion that the drug was not useful. An alcoholic extract prepared from the bark was carefully tested at the School of Tropical Medicine in a number of patients suffering from failure of cardiac compensation with or without dropsy. In none of the patients did the drug produced any marked effects such as are produced by drugs of the digitalis or caffeine groups. The frequency and force of the heart beat and the blood pressure remained appreciably unaltered. The secretion of urine was not markedly affected in these cases. Any therapeutic effects attributed to the drug may be accounted for by the high calcium content to which reference has already been made.

Caius, Mhaskar and Isaacs (1930) have, however, reported that the dried barks of the Indian species of genus Terminalia exhibit a very great variability of forms. There are as many as 15 different varieties (see table above). The barks of these varieties of Terminalia are so very similar in appearance that there is very great likelihood of their being mistaken for one another. In India, practically no distinction is made by the drug-sellers between these varieties and all of them are being constantly exhibited and sold indiscriminately as 'arjuna'. These workers have studied the pharmacological actions of all the barks separately, using hot infusion, decoction and alcoholic extracts of the dried and cleaned bark. The conclusions are given below:—"The pharmacodynamically-active barks of the commoner Indian species of Terminalia are either (*i*) mild diuretics, *T. arjuna, T. belerica, T. pallida,* or (*ii*) fairly potent cardiac stimulants, *T. bialata, T. coriacea, T. pyrifolia,* or (*iii*) both diuretic and cardiotonic, *T. catappa, T. chebula, T. citrina, T. myriocarpa, T. oliveri, T. paniculata, T. tomentosa.*

These conclusions are different from those reported from the Calcutta School of Tropical Medicine. As no active constituent has so far been isolated and as there is practically no change in the chemical compositions of the different barks referred to by Caius and his co-workers it is difficult to conceive how the different varieties reveal quite different

pharmacological and therapeutic effects. The use of alcoholic extracts in pharmacological experiments brings in a lot of abnormal factors which are likely to vitiate the results. Further study is necessary to confirm the findings already recorded.

References :—

(1) Ghoshal, L. M., 1909, *Thesis on Terminalia Arjuna;* (2) Koman, 1919-20, *Report on the Investigation of Indigenous Drugs,* Madras; (3) Chopra, R. N., and Ghosh, S., 1929, *Ind. Med. Gaz.*, Vol. LXIV, p. 70; (4) Caius, J. F., Mhaskar, K. S., and Isaacs, M., 1930, *Ind. Med. Res. Memoirs.*, No. 16, March.

THEVETIA NERIIFOLIA (N.O. Apocynaceæ)

The Exile ; Yellow Oleander.

VERN.—Hind. & Bomb.—*Pila-kaner ;* Beng.—*Kolkaphul ;* Tam.—*Pachch-ai-alari ;* Tel.—*Pach-cha-gannẹru.*

The oleander tree is very commonly met with in the plains all over India and is widely grown in gardens for its beautiful yellow flowers. It is originally a native of the West Indies but has been completely naturalised in India. It is about 12 ft. high with large yellow bell-shaped flowers and linear lanceolate leaves. All parts of the plant abound in milky juice. The fruits are globular, light green, about 1½ inches to 2 inches in diameter and contain a single nut, light brown in colour and of a peculiar triangular shape. Each nut contains two pale yellow seeds. The seeds have long been known to be highly poisonous and have been very commonly used for suicidal and homicidal purposes. As an abortefacient, the seeds have also been used by women in Bengal and neighbouring provinces. Of late, the seeds have come into somewhat extensive use in some parts of the Bombay Presidency as a cattle poison.

Chemical Composition :—De Vry Tijdschr has obtained from the kernel of the seed 57 per cent. of a limpid, almost colourless oil with a density of 0.9148 at 25°C and a solidifying point of 13°C. This oil yields on further extraction, a beautiful crystalline white glucoside to which is given the name of *thevetin.* The presence of the same gluco-

side but to a much lesser extent—4 per cent.—is also recorded by him in the seeds. Warden refers to a principle in the seed which gives a blue colour with hydrochloric acid and another toxic body which is much more powerful than the thevetin of De Vry Tijdschr. Recently (1919), a more detailed study of the glucoside of *Thevetia neriifolia* has been carried out by B. De of the Madras Presidency College (unpublished). The glucoside thevetin was isolated by him in crystals melting at 189-190°C. On hydrolysis, the glucoside breaks up into glucose and an amorphous product which has been named *thevetidine*. Investigations carried out in the Chemical Laboratory of the Calcutta School of Tropical Medicine on the chemical composition of the seeds of Yellow Oleander, confirm the findings of De. The melting point of the glucoside has been found to be 189-190°C. It is sparingly soluble in cold water but fairly soluble in hot water. It is freely soluble in dilute alcohol (50 per cent.) but insoluble in ether, chloroform, etc. An attempt is being made to isolate the second toxic glucoside in a crystalline condition but so far no definite results have been achieved.

Pharmacological Action:—A preliminary study of the glucoside has been conducted by Chopra and Mukerji (unpublished). A watery solution of the drug is readily absorbed from the tissues and does not set up any marked local irritation. The glucoside is not toxic to unicellular organisms such as *Paramœcium caudatum* or multicellular organisms like the helminths. Frogs show definite signs of poisoning, the heart slows down and ultimately stops in systole. Higher animals such as the cat tolerate the drug very badly and die within two hours after the administration of the drug in dosage of 0.2 gm per kilogram of body weight. The heart muscle seems to be affected most and death occurs in diastole from fibrillation of the ventricles. After small doses the systemic blood pressure shows a temporary rise when the drug is injected intravenously but, with the increase in dosage, irregularity in the blood pressure is evident probably on account of the early onset of delirium cordis. Further work is in progress.

Therapeutic Uses:—As has been already said *Thevetia neriifolia* has not been used to any extent in therapeutics on account of its poisonous properties. In the Ayurvedic practice, a tincture of the bark (1 in 5) has been used as an antiperiodic. It is risky to use it as it is very difficult to arrive at the safe dosage without stepping into the toxic limit. The glucoside

contained in the seeds has a powerful effect on the cardiac musculature.

TODDALIA ACULEATA (N.O. Rutaceæ)

VERN.—Sans.—*Kanchana* ; Hind.—*Kanj* ; Beng.—*Kada-todali* ; Rajput.—*Dahan, Lahan* ; Nepal.—*Meinkara* ; Tam.—*Milkaranai* ; Tel.—*Kondakahinda* ; Bomb.—*Jun-li-kali-mirchi.*

Toddalia aculeata is a large scandent shrub found in the Nilgiris and in the sub-tropical Himalayas from Kumaon eastwards to Bhutan, ascending to 5,000 feet above the sea level. This plant early attracted attention as perhaps one of the most valuable of Indian medicinal products. The root bark has been particularly extolled as a potent anti-malarial remedy. It was stated by several prominent physicians in those days to possess an antiperiodic and antipyretic effect, equal to, if not superior to, quinine and other alkaloids of cinchona. The root bark as well as the fresh plant has an aromatic odour and was used in the European medicine under the name of Lopez root. It was also included in the Pharmacopœia of India.

Chemical Composition :—The leaves, on distillation, yield an essential oil with a sharp aromatic odour. Detailed analysis shows that the chief constituent is a camphor-like body with a melting point of 96.5-97°. Citronellal and linalool are also present. The root bark contains an essential oil, resin, a bitter substance, citric acid, pectin, starch, etc. but the chief constituent is berberine which, however, is present only in small quantities.

Pharmacological Action :—An attempt was made by Vyas and Bhatia (1932) to find out if a freshly-prepared infusion of Toddalia has any toxic effect on unicellular organisms such as paramœcia. Their results show that the drug is only very feebly toxic, the toxicity being about one-fifth of that of cinchona. Further pharmacological study is necessary in order to pronounce any definite opinion regarding the action of the drug.

Therapeutic Uses.—The alleged anti-malarial properties of the root bark have recently been tested by Vyas and Bhatia

in the hospitals of the King George's Medical College, Lucknow (1932). They used a tincture of the root bark in ½ to 1 drachm doses. Out of 26 cases of proved malaria treated with Toddalia mixture, 23 cases showed a persistent presence of the parasites even on repeated blood examinations. The symptoms appeared to have abated in only a small proportion of the cases (3 cases) which might also happen even when no treatment is given. These workers conclude that the alcoholic extract of Toddalia prepared from the root bark has no effect on the clinical symptoms or on the malaria parasites present in the blood of patients.

References :—

(1) *Report*, 1893, Schimmel & Co., April, Vol. 64; (2) Perkin and Hummel, *Jour. Chem. Soc.*, 1895, p. 413; (3) Vyas and Bhatia, 1932, *Ind. Med. Gaz.*, p. 192.

TRIBULUS TERRESTRIS (N.O. Zygophylleæ)

Small Caltrops

VERN.—Sans.—*Gokshura* (cow's hoof), *Ikshugandha* ; Hind.—*Gokhru*, *Chota* ; Beng.—*Gokhuri* ; Mar.—*Lahana gokhru* ; Punj.—*Kurkundai* ; Tam.—*Nerunji* ; Tel.—*Palleru-mullu*.

Tribulus terrestris is an annual or perennial plant growing throughout India and other warm countries such as Ceylon. The entire plant and specially the fruit and the root are used in the Hindu medicine. The fruits are regarded as cooling, diuretic, tonic and aphrodisiac, and are used in painful micturition, calculus affections, urinary disorders and impotence. In Nothern India it is used against suppression of urine, cough and heart diseases in the form of an infusion. The fruit forms one of the ten ingredients of the 'Dasamula kvatha', a compound decoction often mentioned in Sanskrit works.

The plant commonly grows near the Dardanelles and was known to the old Greek physicians. It is used in South Europe as an aperient and diuretic. The action of the drug on the mucous membrane of the urinary tract resembles that of buchu leaves and uvaursi flowers. It has been combined with

hyoscyamus and opium in inflammatory conditions of the urinary passages.

Chemical Composition :—The drug was analysed many years ago and was found to contain a body of alkaloidal nature. The fruit is said to contain a substance having an aromatic smell and it gives off a fragrant odour when it is burnt. The drug was reinvestigated by the author and his co-workers with a view to confirming the previous work and to see if it could be advantageously employed in therapeutics.

The following substances were found in the fruit of *Tribulus terrestris* :—(1) an alkaloid in traces (0.001 per cent), (2) a fixed oil 3.5 per cent. consisting mainly of unsaturated acids, (3) an essential oil in very small quantities, (4) resins, and (5) fair amounts of nitrates.

An aqueous solution of the tartrate of the alkaloid was passed through preliminary pharmacological tests. It produced a slight rise of blood pressure and an appreciable increase in the kidney volume. The yield of the crude alkaloid did not amount to more than 0.001 per cent. and therefore sufficient quantities could not be obtained for further study. A method of its separation by precipitation with Meyer's reagent was tried, but this also did not produce any better result. The aqueous solution after removal of the alkaloid was found to contain sugars, etc., but no physiologically-active substance.

Clinical Trials :—An alcoholic extract of the drug was prepared and tried in a series of cases. The drug undoubtedly has diuretic properties, but shows no advantage over many of the diuretics in the British Pharmacopœia. The diuretic properties no doubt are due to the large quantities of the nitrates present as well as the essential oil which occurs in the seeds. The claims put forward regarding its efficacy in other conditions above stated cannot be substantiated.

References :—

Chopra, R. N., and Ghosh, S., 1929, *Ind. Jour. Med. Res.*, Vol. XVII, p. 377.

VERNONIA ANTHELMINTICA (N.O. Compositæ)

VERN.—Sans.—*Vakuchi, Somaraja* ; Hind.—*Bakchi, Somraj* ; Beng.—*Somraj* ; Bomb.—*Kali-jiri* ; Guj.—*Kadvo jiri* ; Tam.—*Kattu-shiragam* ; Tel.—*Adavi-jilakara*.

It is a stout annual with a cylindrical stem, oval or lanceolate leaves and pale violet flowers. It is commonly

found in waste lands near villages throughout India. The seeds are highly reputed in Hindu medicine as a remedy for leucoderma and other skin diseases. They are mentioned also as an anthelmintic but are little used as such except in combination with other drugs. Chakradatta describes several elaborate combinations for its external and internal use. This drug attracted the attention of the European physicians in India early and an infusion of the powdered seeds was considered by many to be a good anthelmintic for roundworms.

Chemical Composition :—The seeds are said to contain resins, an alkaloid known as vernonine, an oil and ash amounting to about 7 per cent. of the dry material. Their chemical composition was reinvestigated in the School of Tropical Medicine. The powdered dry seeds, when extracted successively with different solvents, gave the following extracts :- petroleum ether 18.4 per cent.; chloroform 1.2 per cent. and absolute alcohol 13.8 per cent. The petroleum ether extract consisted mainly of a fixed oil (about 18 per cent. of the seeds) and a very small amount of an essential oil (about 0.02 per cent.). The chloroform extract contained a bitter substance. The alcoholic extract consisted mainly of resins. There was no alkaloid present.

The bitter principle, which was presumably the active principle of the drug, amounted to over 1 per cent. of the weight of the seeds. It was isolated on a larger scale by extracting the powdered seeds with rectified spirit until all the bitter substance was removed. The alcohol was recovered and the residue repeatedly extracted with chloroform and filtered. The chloroform extract was concentrated and the bitter substance precipitated with petroleum ether. This process was repeated several times until the bitter substance was obtained as a yellow, amorphous powder. It contained no nitrogen or sulphur and behaved as a resin acid.

Therapeutic Uses :—The powdered resin, in doses of 5 to 10 grains, was tried in a number of cases of helminthic infections at the Carmichael Hospital for Tropical Diseases. The stools were carefully examined before and after the drug was given. The resin appears to have very little effect on the ascaris. It is, however, distinctly effective in threadworm infections. In several children in whom the resin powder was administered, threadworms were expelled in the stools in large numbers and the symptoms which are often very troublesome, *e.g.*, nocturnal enuresis, grinding of the teeth at night, etc., were relieved. Further work is in progress.

VITEX PEDUNCULARIS (N.O. *Verbenaceæ*)

VERN.—Hind.—*Nagbail, Nagpheni, Charaigorwa, Minjurgorwa* ; Beng.—*Boruna* ; *Goda* ; Assam—*Osai* ; Santal—*Bhadu, Marak* ; Kan.—*Navaladi* ; Burm.—*Kyetyo.*

Vitex peduncularis is a middle-sized or large deciduous tree which grows in Bihar, Eastern Bengal and the Central Provinces. The plant does not seem to be very well-known as the only reference regarding its medicinal properties by the old writers is its use for external application for pains in the chest. Vaughan (1921) found that the aboriginal tribes of certain parts of Bihar were well acquainted with this plant and used it in the treatment of malarial fevers and also of blackwater fever which sometimes occurs among them. They prepare an infusion of the leaves or of the root bark or young stem and take it internally several times a day with much benefit. Preference is given to dark-coloured root plant over the pale-coloured variety.

Chemical Composition :—Systematic chemical examination did not reveal the presence of any active principle. Small traces of an alkaloid were found; the quantity, however, was so small that further investigations were not possible.

Clinical Trials :—Vaughan tried this drug in a series of cases in both these diseases and reported that it gave very satisfactory results. He originally used the method of making an infusion employed by these tribes. This consisted in taking two ounces of fresh leaf or of leaves dried in the shade and dropping them into 40 ounces of water, boiling for 5 to 10 minutes and then leaving them to infuse for another hour. The resulting infusion was about the colour of strong cold tea in appearance and in taste, and was given sweetened with a little sugar in doses of 8 to 10 ounces in 24 hours. Concentrated infusions prepared on the lines of infusio gentianæ compositum of the British Pharmacopœia were also tried by him, but the therapeutic effects were not so good. He adopted the method of using 1, 2 and 4 ounces of leaves in 40 ounces of water to suit different cases and the results obtained by this treatment were said to be very striking.

The drug was tried in a number of patients suffering from malarial fever at the Carmichael Hospital for Tropical Diseases. The results obtained were, however, not satisfactory and did not give any indication of usefulness of the preparation. Fresh specimens properly collected were then obtained and infusion made from these was tried in another series of cases. All the cases which were put on the infusion were first

examined for malarial parasites and only such cases as were positive were given the infusion. Daily blood films were taken and a careful search was made for parasites. No other drugs were administered whilst the infusion was being tried with the exception of ordinary purgatives. None of the cases derived the slightest benefit from the use of the drug. The parasites in the blood remained quite unaffected and so did the clinical symptoms. In one or two cases the fever abated somewhat, as often happens without any treatment, but in these cases parasites were still found in the blood films. In two of the patients the infusions had to be replaced by quinine mixture after two days' trial, as the patient started to show signs of irritation of the central nervous system. A few doses of the latter drug immediately got the symptoms under control.

Neither the asexual nor the sexual forms of *P. vivax, P. malariæ or P. falciparum*, were affected in the slightest degree. In all these cases quinine or cinchona febrifuge in the usual doses produced a rapid disappearance of parasites from the blood and the fever and other symptoms rapidly subsided.

Summary :—Chemical analysis of the dried leaves of *Vitex peduncularis* shows the presence of minute traces of an alkaloid. In our series of cases of malarial fever, however, caused by *P. vivax, P. malariæ* and *P. falciparum*, the freshly-prepared infusion of dried leaves had no effect whatever on the parasites in the blood, on the temperature chart or on the other clinical symptoms. The drug appears to be absolutely useless in the treatment of malaria.

References :—

(1) Chopra, R. N., and Knowles, R., 1924, *Ind. Med. Gaz.*, Vol. LIX, p. 133.

SECTION II

DRUGS OF MINERAL AND ANIMAL ORIGIN

Most of the recent investigations on the Indian indigenous drugs have been confined to drugs of vegetable origin. The reason of this is not far to seek. The vegetable drugs from the very early times have formed a predominant portion of the materia medica of both the Hindu and the Mohammedan medicine in this country. The drugs of animal origin, although very largely used in the ancient Chinese materia medica, were very little used by the Hindu physicians and are few in number. As regards the drugs of mineral origin, their use is also comparatively limited. It would appear that the ancient Hindus were not quick in learning the art of adopting the metals and metallic compounds for medicinal purposes. It is well-known that one of the earliest works on Hindu medicine by Charaka does not deal at all with any mineral drug. Susruta, written at a later period, only mentions the use of a few natural salts such as sodium chloride, impure carbonates of sodium and potassium, borax and some salts of iron, silver, copper, tin and lead as well as some precious stones. Only writers of considerably later periods gave descriptions of calcination and purification of compounds and other processes of converting such metals as gold, silver, iron, copper, mercury and arsenic into suitable forms for use as medicaments. The Mohammedan physicians though they used the drugs of animal origin to a larger extent than the Hindus, also made use of the inorganic preparations to a limited extent. Many of their methods of preparation of these medicaments resemble those used by the Hindus. Before using the metals or metallic compounds, they are always subjected to processes called 'shodhana' or purification. The idea of this is to get rid of the impurities and their deleterious qualities. If this 'shodhana' is not performed, their use is said to be injurious to the individual. 'Shodhana' is usually carried out by heating thin sheets of metal repeatedly and plunging them into various vegetable juices, decoctions, etc.

The other process described is 'marana' or destroying the metals so that they lose their identity and become converted into fine powders which are chemically of the nature of oxides or sulphides. Here the idea appears to be to convert the metals into such a form as can be acted upon by the intestinal juices and so rendered absorbable. These preparations are absorbed very slowly and in this way minute concentrations having a stimulant action on the tissues are obtained and higher toxic concentrations are avoided. Many of the other inorganic compounds in use are practically the same as those used in the Western medicine and their action is well-known. Very little, however, is known about the action of the second group of destroyed metals and it is to the absorption and effects of these compounds that attention of the workers may be directed. In this section we have discussed a very few drugs ; the attention of the reader is directed to the list in Part IV.

MAKARADHWAJA

Makaradhwaja is a well-known inorganic preparation of the Hindu Pharmacopœia. Its use can be traced to the time of Bhabamisra, the renowned Hindu physician, who lived in the early part of the 16th century. Since then, the preparation has been in constant use and is to this day held in very high esteem by the Ayurvedic practitioners. This drug has such a great hold on the minds of the people in India that many practitioners of the Western medicine also use it. There is probably something of real value about it as it has resisted the ravages of time for many centuries and is universally esteemed to the present day. An enquiry into the mode of action of this remedy may, therefore, prove beneficial and with this idea in view, we have thought it worth while to introduce a short discussion on it so as to draw the attention of the research workers.

Preparation of Makaradhwaja:—It is necessary at the outset to outline the process of preparation of this drug, as according to the Ayurvedic pharmacopœia a great deal depends on the method adopted. Various methods have been described in

books on Hindu medicine. The description given below has been kindly given to us by an eminent practitioner of the Ayurvedic medicine in Calcutta and is believed to be the standard method *laid down in books of the Hindu materia medica.*

Eight parts of pure mercury and one part of gold leaf are mixed together to form an amalgam. To this mixture, sixteen parts of sublimed sulphur are added and the resulting mixture is rubbed very thoroughly in a stone mortar for 24 hours or more until the whole is converted into a lustreless, fine, impalpable powder of uniform consistence. This powder should be light enough to float on water and there should be absolutely no lumps or grit in it when rubbed between the fingers. This is known as 'kajjali' in Sanskrit and its chemical composition is said to be the same as black sulphide of mercury. This preparation forms the basis for the 'makaradhwaja'. The 'kajjali' is placed in a narrow-mouthed bottle and is gradually heated on a sand bath. When the temperature reaches a certain limit the bottle is filled with reddish fumes of various hues. On cooling 'makaradhwaja' is found deposited on the inner surface of the bottle. The sublimed powder is collected by breaking the neck of the bottle and scraping off the deposit, which is then preserved in a clean dry vessel for future use.

A great deal of stress has been laid by the Hindu physicians on the purification of mercury employed for the preparation of this drug. The mercury used has to be passed through various methods of purification laid down in the Ayurvedic books before it can be accepted for use. These processes are known as 'sodhana'. It may be mentioned in this connection that the processes described for 'sodhana' are very tedious and complicated. Judged from the standpoint of modern chemistry, these methods of purification have very little to recommend them and in many instances impurities from extraneous sources are actually introduced in the different stages of the processes, rather than removed.

Administration of Makaradhwaja in Hindu Medicine:—Makaradhwaja is seldom used alone. In the majority of cases, it is mixed with various drugs called 'anupana' or adjuvants. Thus in cases of indigestion and diarrhœa, 'makaradhwaja' is

mixed with powdered 'bael' fruit (*Ægle marmelos*) ; in cases of fever and cough it is given with the juice of ginger, betel leaves (*Piper betle*) and 'tulsi' leaves (*Ocimum viride*) ; in heart disease it is combined with musk. In the absence of proper 'anupana' (adjuvant), honey may be used in every case. The usual procedure is to take a dose (approximately one grain) of 'makaradhwaja' with 60 drops of the 'anupana' or honey and rub it for sometime in a stone mortar before administration. The medicine may be used both for adults and children, the dosage being regulated according to age. 'Makaradhwaja' when taken regularly is believed in the indigenous system of medicine to be a wonderful tonic and is said to increase the longevity of the patient.

The Composition of Makaradhwaja :—Chemically, 'makaradhwaja' is identical with the red sulphide of mercury. This sulphide occurs in nature as the mineral ore called *cinnabar* in many parts of the world particularly in California, China and Spain. In the vernacular, cinnabar is known as 'hingool' and is to be found in Nepal. 'Hingool' found in the Calcutta market is not the natural ore, but is artificially prepared by heating mercury with sulphur in a retort. This substance, except for the slight impurities which it might contain, has the same composition as 'makaradhwaja'. In the Ayurvedic practice, however, 'hingool' and 'makaradhwaja' are claimed to possess entirely different properties. Not only is it considered different from 'hingool' (the natural red sulphide of mercury), but it is also thought to be different from the artificial sulphides of mercury like 'kajjali' and 'krishna-parpati' (both of which resemble black sulphide of mercury in composition) and 'rasasindura' (red sulphide of mercury). These differences are rather difficult to explain from the modern scientific point of view. It is claimed by the Ayurvedic practitioners that 'makaradhwaja' is not ordinary red sulphide of mercury but is a combination of sulphide of mercury with gold. This gold is not in a chemically combined condition but its presence in a very fine state of division alters the property of the drug to a considerable extent.

Pharmacological Action :—Most of the soluble salts of mercury are absorbed slowly from the intact mucous membrane

of the alimentary tract and produce their systemic effects. The insoluble mercurial salts, however, are very sparingly absorbed. Mercurous chloride and mercurous iodide are known to be absorbed as mercury can be detected in the urine after their administration. It has been found that after administration of 0.6 gm. of calomel and 20 mgm. of mercurous iodide daily, 5 mgm. and 4 mgm. of mercury respectively are excreted in the urine. In the case of sulphides, however, a great deal of doubt exists as to whether they are absorbed at all. The sulphide ion is very inert and it is clear that unless and until, the salt is dissociated into its constituent ions, mercury will not be able to exert its influence on the body tissues. Sulphide of mercury is not used in any of the Pharmacopœias of Western countries as it is considered to be devoid of therapeutic activity. This idea gains additional support from the fact that the various mercurial salts after absorption are excreted into the cæcum and colon as sulphides and in this form, mercury is found in the fæces. In the Ayurvedic Pharmacopœia, on the other hand, mercury is predominantly used in the form of sulphides. It is indeed strange that a country, where this metal was first harnessed into the service of medicine, should have chosen an insoluble and possibly an inert salt for therapeutic uses. Investigation was therefore carried on to determine whether this salt is at all made soluble under ordinary physiological conditions in the gut and whether the mercury ion liberated from this so-called inert combination can be utilised by the tissues.

Experimental :—Ghosh (1931) has recently shown that 'makaradhwaja' and other sulphides of mercury in a fine state of division undergo solution in 5 c.c. of a 0.2 per cent. solution of HCl at 100°F in an hour. This is also true when these sulphides are digested with filtered gastric juice obtained artificially from a healthy patient. If sulphide of mercury is broken up in this manner by the acid of the gastric juice, it is likely that absorption will take place. By feeding a young dog with finely powdered 'makaradhwaja' once a day for three consecutive days, he has further shown the presence of mercury in the liver. From these observations, he concludes

that the insoluble sulphides are changed into soluble chlorides by the action of the gastric juice and in this form mercury is absorbed into the system *via* the portal circulation and stored up in the liver and other organs. This observation was based on only one animal experiment and cannot, therefore, be considered a definite proof of the absorption of the metal. In order to confirm the findings, the absorption of the drug from the stomach and intestines was studied by the following methods. The abdominal cavity of guinea pigs was opened under ether anæsthesia in the epigastric and iliac regions as required and sterilised catgut ligatures were placed at the pylorus in three animals and at the ileo-caecal junction in two other animals. An incision was made into the wall of the stomach and finely powdered 'makaradhwaja' suspended in honey was introduced directly into the cavity through the wound. The abdominal wounds were sutured and the animals allowed to recover from the anæsthesia. After this operation, the animals generally died within 24—30 hours. *Post mortem,* the small intestines and the colon were ligated separately and their contents examined for the presence of mercury. Under ordinary circumstances, if the insoluble sulphide of mercury is converted into the soluble chloride and is absorbed into the system, it would be possible to obtain some evidence of the presence of mercury either in the liver where it would have been stored or in the colon washings where it would have been excreted. As nothing has been allowed to pass through the pylorus in the first three animals and through the ileo-caecal valve in the other two, the presence of mercury in the colon would be a fairly reliable indication of its absorption and circulation in the blood. In all the guinea pigs where 'makaradhwaja' was introduced into the stomach in the manner described above, we could not detect the metal in any of the washings from the intestinal tract, neither was there any definite indication of its storage in the liver, at least in sufficient amounts to be distinguishable by the ordinary chemical tests for mercury. From these experiments, it may be said that mercury in the form of 'makaradhwaja' is not absorbed either from the stomach or

from the small intestines. It is, however, likely that very minute quantities are absorbed and excreted and the ordinary chemical tests are not sensitive enough to detect its presence. Further investigations with improved methods of identification of mercury are therefore called for.

Excretion of the drug was next studied as the rate of elimination is a very good index of the rate of absorption and presence of a drug in the blood and tissues. 'Makaradhwaja' was obtained from reliable sources as most of the preparations in the market are said to be adulterated. It was administered to several healthy patients in doses of 1 to 2 grains (65 to 130 mgm.), following strictly the directions of the Ayurvedic practitioners. The drug was thoroughly rubbed in a stone mortar for about 15 minutes before administration to convert it into a fine, impalpable glossy powder and was mixed with pure honey as a vehicle. It was given daily for one week. After the first 3 days, samples of the urine were collected daily and examined according to the methods to be described later. Individual samples as well as samples from 24 hours collections (kept with toluene to prevent decomposition) were examined. Most of the patients were our laboratory assistants who were healthy young men and were under strict control.

In such a study, the excretion of the metal in both the urine and fæces has to be considered. Most of the analytical methods of estimation of the metal in vogue contain inherent faults and any conclusions drawn as a result of estimation by these methods, are likely to be fallacious. Booth, Schreiber and Zwick (1926) have described a new analytical method which has been claimed to yield accurate results and permits of the estimation of 5 mgm. or less of mercury in a litre of the solution in presence of organic matter. In principle, it consists of the oxidation of the excreta by digestion with sulphuric acid and potassium permanganate, precipitation of the mercury as sulphide and enmeshment of the precipitate by gelatinous manganic hydoxide. The washed and dried precipitate is ground up with lead chromate and decomposed by heating in a glass tube at 550°C for 3 hours. The volatilized metallic mercury is condensed in the cooler portion of the tube. When

the entire mercury has separated, it is collected into one globule, transferred to a calibrated capillary tube, the length of the column measured micrometrically and transposed to the corresponding weight. As this method entails the selection of cases who have to be kept under strict hospital supervision for the purpose of collection of the daily excreta for weeks, mercury excreted in the urine was estimated as a preliminary measure. The following method which is a slight modification of the original Bardach's method, was used.

To 250 c.c. of well shaken unfiltered urine, 5 gms. of aluminium sulphate and ammonia were added. The mixture was then heated and filtered while hot. The precipitate was washed with hot water and dissolved in concentrated HCl. A bright clear copper foil was introduced into the solution and set upon a water bath for 45 minutes. The amalgamated copper foil was removed, washed with distilled water and then with alcohol and finally with ether and dried in the air. A minute particle of iodine was introduced into a test tube and the copper roll was put in and gently heated. A yellowish or reddish deposit indicates mercury. This test is quite sensitive and allows the detection up to 0.01 mg. of mercury in a solution.

In seven healthy individuals experimented upon, no traces of mercury could be detected in the urine by this method. The stools in some of these cases are being examined but the results are not yet conclusive. Further observations on these lines are being conducted with administration of makaradhwaja for 2, 3 and 4 weeks and the results will be reported in due course.

Therapeutic Uses :—'Makaradhwaja' is commonly used as a tonic in debilitating conditions and in convalescent patients after acute illness. In failing circulation and in cardiac asthenia, 'makaradhwaja' is considered to be a sovereign remedy. Recent work has shown that the mercury ion in a high state of dilution has a definite stimulant action on animal tissues. One in one million of mercuric chloride added to the perfusate distinctly stimulated the isolated mammalian heart and increased its force of contraction. It is therefore likely that if absorption does take place in very small quantities, 'makaradhwaja' would produce a stimulant action on the heart.

In view of this work, the drug was tried in some cases of myocardial disorders following acute specific fevers. That there was distinct clinical improvement in the condition of individual patients after the administration of the drug for a period of 15 to 20 days, there seemed little doubt but extended trials are necessary before a definite opinion can be given. Mercury preparations have been used for many years as tonic and alterative in the western medicine. There seems to be very good reason for such use as it has been shown that small doses of mercury diminish the amount of oxidation of the tissues, as evidenced by the variations in the gaseous interchange. Further, the administration of small doses of mercury to rabbits, dogs and men causes an increase in the number of red blood corpuscles while the body gains in weight and the general nutrition is improved. Larger doses, however, have been found to act in the reverse way by causing a diminution in the amount of hæmoglobin, in the number of corpuscles and in the weight. Most of the preparations of mercury in use in the British Pharmacopœia are rapidly absorbed, so that larger quantities of mercury ion than are good for the system, are probably taken up. It is quite possible that in 'makaradhwaja' we have an insoluble preparation which by action of the gastro-intestinal juices is rendered absorbable to such an extent that minute quantities of mercury ions sufficient for stimulation of the tissues and no more, are taken into the system and are acting on the tissues.

'Makaradhwaja' is also used as a laxative with good results particularly in those cases when there is visceroptosis and atonic condition of the gastro intestinal tract. As an intestinal antiseptic also, it is said to be of great utility and is supposed to relieve the gaseous distension of bowels due to fermentation. How far this is true has yet to be investigated, but mercury is known to be a powerful and readily diffusible protoplasmic poison which acts in very high dilutions against lower forms of life. Recent researches on the intestinal antiseptics have shown that calomel is one of the few drugs which produces alteration in the intestinal flora and brings about an appreciable decrease in the bacterial contents of the gut. In view of these facts it

is not unlikely that the claims made for 'makaradhwaja' in this connection may be borne out by further research.

References :—

(1) Ghosh, H., 1931, *Indian Medical World*, April; (2) Booth, Schreiber and Zwick, 1926, *Jr. Amer. Chem. Soc.*, Vol. XLVIII, 1815, July; (3) Chopra, R. N. and Mukerji, B., 1932, *Ind. Med. Gaz.*, August.

MOSCHUS MOSCHIFERUS

Musk

VERN.—Sans.—*Mriganabhi, Kasturi* ; Hind.—*Kasturi* ; Beng.—*Kasturi* ; Tam. & Tel.—*Kasturi* ; Mar. & Guj.—*Kasturi* ; Burm.—*Kado.*

The term 'musk' is loosely applied to a number of products of both animal and vegetable origin characterised by the peculiar odour of the true perfume. Musk proper is the dried secretion from the preputial follicles of the musk-deer or *Moschus moschiferus*. The animals are found in China, Russia, Assam, Central Asia and in the pine forests and inaccessible cliffs of the Himalayas at elevations of about 8,000 feet. Musk is found in these animals only in the rutting season and is undoubtedly for the purpose of attracting the female. The season during which musk is present in the skin gland covers about one month and in order to secure the valuable secretion of the gland, the animal must be caught in that period. No musk is obtainable from animals in the other seasons of the year. The contents of the pod vary in bulk with the age of the animal. A yearling yields scarcely any musk, and a two-year-old fawn has in its skin gland contents one-eighth of an ounce of musk, which is milky, and has an unpleasant smell. A full-grown buck gives about two ounces, but specimens containing one-third to one-half of an ounce of musk are not uncommon. The material is found embedded in a sac which is oval or round with a diameter of about 1½ inches ; the upper surface is flat with a smooth membrane and the under surface is covered with stiff hairs arranged concentrically round a small opening. Though the

quantity is small, the odour is so strong that it can be perceived at a distance when the animal is shot and it is said that the hunters very frequently suffer from the strong odour emanating from the fresh musk as it acts deleteriously on the nervous system, eyesight and hearing. Chinese traders say that the best kind of musk is not obtained from captured animals, but is gathered from the favourite haunts of the deer after the rutting season, when the animal breaks the gland with its hoofs and empties the contents on the ground. Musk of this kind is extremely difficult to obtain and is, therefore, rarely seen on the market.

Musk in the Animal and Vegetable Kingdoms:—It is interesting to note that odorous substances of the nature of musk occur both in the animal and vegetable kingdom in the different parts of the world. According to Gerardin, the following animals secrete musk or similarly odorous substances:—the male musk-deer, *Moschus moschiferus;* the gazelle, *Antilope dorcas;* the marten, *Mustela foina,* the fæces of which are said to have a musk-like odour; the alpine goat, *Capra ibex,* the dried blood of which smells like musk; the musk-ox, *Ovibos moschatus* which disseminates a decided musk odour and the meat of which, though it has a repulsive odour and taste, is eagerly eaten by the Indians; the zebu, *Bos indicus;* the pecari, *Dicotyles torquatus;* the musk-duck, *Anas moschata,* which is found on the Gold Coast, in Jamaica and Cayenne; the desman, *Myogal moschata;* the Nile crocodile, *Crocodilus vulgaris;* various turtles, *e.g.*, *Cinosternon pennsylvanianum* ; and various Indian snakes.

The musk odour is also found quite commonly in the vegetable kingdom. It is found in *Malva moschata* and the seeds of *Hibiscus abelmoschus,* Linn. (Malvaceæ) which are utilised in perfumery; *Brassica oleracea,* Linn. var. *capitata* (Cruciferæ); *Erodium moschatum,* Hér. and *Geranium triste* or *Pelargonium noctuolens* of Western Africa which is odorous at night (Geraniaceæ); *Rosa moschata* (Rosaceæ); the wax gourd, *Benincasa cerifera,* Sav. and the Indian bottle gourd *Lagenaria vulgaris,* Ser. (Cucurbitaceæ); *Adoxa moschatellina,* Linn. (Caprifoliaceæ); *Achillea moschata,* Jacq., *Aster argophyllus,* Labill. and *Moscharia pinnatifida,* Mol. of Chile (Compositæ); *Hyssopus officinalis,* Linn. and *Moschosma* species of India and Africa (Labiatæ); *Mimulus moschatus* of Chile and North America (Scrophulariaceæ); *Moschoxylon swartzii,* Juss., the musk wood of Jamaica (Meliaceæ); *Guarea grandiflora* of America and the poisonous *Serjania curassavica,* Radlk. of America (Sapindaceæ); the wood of the American *Clusia eluteria* (Clusiaceæ); the Asiatic *Lawsonia inermis,* Lam. (Lythrarieæ); the East Indian *Ferula sumbul,* Hook. (Umbelliferæ); the wood of

Cordia rumphii, Bl. of Java (Boragineæ); *Pedalium murex=Peturaga cingul* of Ceylon (Pedalineæ); *Cestrum nocturnum*, Linn. of South America (Solanaceæ) and the Mexican wonderflower, *Mirabilis longiflora*, Linn. (Nyctaginieæ), the last two named exhaling a musk odour at night.

Despite the large number of products capable of affording more or less a musk-like odorous substance, the musk-deer remains the only important commercial source of this substance.

Preparation of Musk for the Market:—There are several ways of preparing the commercial musk, and the best method is to dry the pod by sunning and airing immediately after it is taken from the animal. The article, because of its powerful diffusion of odour, is usually packed in hermetically sealed vessels and wooden boxes lined with tin foil. The pods from the places of production are always packed in small skin bags singly, the pod inside the bag being covered with the animal's hair or similar stuff to keep its odour from diffusing as well as to protect it from the influence of the weather. For home consumption, Chinese traders occasionally pack the pods in silk-wrapped packages of two or three dozens each. Musk is collected from the hunters by a class of traders, who are also engaged in exporting medicinal herbs and other products of the highlands of the Szechwan Tibetan border, no Chinese merchant being engaged exclusively in the musk trade.

Composition and Physical and Chemical Characters:—Musk when fresh is milky but later turns viscid and assumes a brownish red colour. It retains its odour for a long time and has a bitter aromatic taste. It is soluble in alcohol to the extent of about 10 per cent., in water to about 50 per cent. and also in ether and alkalies. It stains the paper yellow and gives a urinous smell on heating. It contains ammonia, olein, cholesterin, fat, wax, gelatinous matter, albuminous substances and leaves an ash, which contains chiefly the chlorides of sodium, potassium and calcium. Musk yields by distillation with steam and subsequent purification, a small percentage of a viscid, colourless oil with a very powerful and agreeable odour of musk; this oil appears to be a ketone and has been termed muskone. Musk is remarkable for the power, permanency and stability of its odour, everything in its vicinity becoming affected by it and retaining the scent for a long time. It has been highly valued in perfumery, and though now not used alone is very largely employed to give permanence and strength to other odours. Perfumers use the scent for imparting an odour to soaps, powders, and in mixing liquid perfumery. Its fragrance is completely destroyed by contact with bodies such as camphor, valerian, bitter almonds, garlic, hydrocyanic acid and powdered ergot.

Commercial Varieties:—There are three kinds of musk to be distinguished in commerce. (1) The Russian musk. This variety

possesses a poor fragrance and hence is not much esteemed. (2) The Assam musk. It has got a very strong odour and fetches a much higher price than the first variety. In books on Hindu Medicine, Assam musk is described as 'Kamrup musk'. It is black in colour and has been considered to be the best variety available. (3) The Chinese musk is at present the most highly prized because of its freedom from any unpleasant smell suggestive of ammonia which is sometimes found in the inferior brands. The bulk of the musk exported from China comes from Tibet, the home of the musk-deer. It is bought up by the musk dealers of Tatsienlu, whence it is carried to Chungking. The variety of musk known in commerce as 'Tonkin musk' and chiefly used in perfumery comes from Western Szechuan and the eastern extensions of the Tibetan high plateau. Prior to the opening of steamer traffic on the Yangtse river in the past century, this variety of musk was exported *via* Tonkin to the south and it has retained the name Tonkin musk to this day. The chief market for this article in the interior is located in the city of Tatsienlu, close to the border of Tibet. In the province of Yunan, a certain quantity of musk is also obtained but it plays no role in commerce. A larger quantity comes to the market from the northern parts of Mongolia and Manchuria and from Eastern Siberia. This musk is known as 'cabardine' musk but is not used for first class products because of its penetrating unpleasant odour.

Adulteration of Musk :—On account of the great demand and the difficulty of obtaining it, musk is very frequently adulterated with inert substances such as dried blood, liver, etc. Vegetable products such as beans, wheat grains, barley grains, etc., are also mixed with the commercial article at the time of preparing. As musk quickly imparts its peculiar scent to other substances with which it comes in contact, detection of adulteration from smell becomes difficult. Several methods are in vogue amongst the Chinese and Tibetan dealers, which though not very scientific, are said to afford fairly good indications as to the genuineness of the article. Whenever any doubt exists, a few grains are extracted from the pod and placed in water. If these remain granular the musk is genuine, and if these melt the musk is false or adulterated. Another test is to place a few grains on a live piece of charcoal. If these melt and bubble, the musk is pure; if they at once harden and become cinder, it is adulterated. Genuine musk even when buried does not change its odour, while impure or adulterated musk gives out an entirely different smell. Adulterated musk can also be detected by touch. Genuine musk is soft and adulterated musk is stiff to the touch. An interesting popular test for musk has been reported from the Punjab. A thread is passed through asafœtida and then through the musk pod. If after this, the smell of asafœtida remains, the musk is not genuine.

Artificial Musk :—Since musk fetches a high price on the market, the unfortunate little animal—the musk deer—has been ruthlessly hunted for its valuable scent pod. Fear has been expressed by foreign naturalists for the early extinction of the animal if the present rate of destruction is allowed to go on without any restriction. It is estimated that at least twenty-two pods are required to make one 'catty' of musk. (1 catty=$1\frac{1}{3}$ lb.). Thus twenty-two male deer must be killed before the trade can bring one catty of musk pods to the market. As the musk sac is found on the abdomen of the buck only, and as there is no distinction in appearance between the male and the female deer when seen at a distance, many more animals of both sexes must be caught or killed, in order to secure a catty of musk pods. As the animals are hunted or trapped during the rutting season, they are getting exterminated and this fact, coupled with the increasing consumption in perfumery of the article in France, has led the chemists to look for some substitute of the natural article which can be prepared in the laboratory. Compounds having the odour of musk have been prepared synthetically but such substances have an entirely different chemical structure from the natural musk. These are, however, not poisonous and are largely substituted in the cheaper forms of perfumery for the expensive natural product. The musk substitutes at present known are trinitro-meta-tertiarybutyl-toluene and the corresponding compounds obtained from the homologues of toluene and the dinitro derivatives of the ketones which are formed by the interaction of acyl chlorides on derivatives of toluene. Of these, *Trinitrobutyltoluol* $C_6HNO_3CH_3C_4H_7$ has been considered to be the best. Its odour is very akin to the natural musk and is sold in perfumery under the name of artificial musk.

Commercial Importance of Musk :—Musk is very largely used in India and in the Far East. Besides its medicinal use, musk is employed extensively in perfumeries. France is the largest buyer, taking about one-third of the exports. Some idea of the commercial importance of musk can be obtained from the fact that the annual value of the exports from China alone varies between £70,000 and £100,000, to say nothing of the large quantity which is retained in China itself, where it is used not only as a base for perfumes but as an ingredient of stimulating medicines. It is said that some six years ago the Lamas of Tsarung in South-East Tibet, owing to the relentless killing of the musk-deer, issued an edict prohibiting hunters from catching or killing the animal on very severe penalty. The edict is quoted as saying that any hunter caught killing musk-deer will have his hands cut off and nailed on the temple door. In spite of the Lamas' decree, with its terrible penalty, the quantity of musk brought out from the Tibetan border every year is fairly large.

A good deal of musk is also exported to the United Kingdom and other parts of the globe from India. According to Watt, total

amount of musk exported from India during a period of ten years from 1878-1888 was 44,195 ounces worth about Rs. 11,17,579.

PHARMACOLOGICAL ACTION:—Little is known regarding the pharmacological action of this popular remedy. Most of the experiments recorded have been conducted with samples of musk obtained from the market which are likely to be, and as a matter of fact are, always highly adulterated. The tinctures of musk, both imported and indigenous, are not above suspicion. With a view to obviating any possible error in our observations, we obtained genuine samples of musk from a well-known practitioner of the indigenous system of medicine. These samples were collected from the original pods from musk deers killed in the territories of the Rana Saheb of Tharoch (Simla Hill States) and also from reliable dealers in Kashmir.

Solutions for pharmacological experiments were prepared in our laboratory by macerating the musk in a small quantity of alcohol and dissolving the whole in water, and keeping it for 24 hours. If the sample is moist, it can be dried in a vacuum desiccator over sulphuric acid when it loses nearly 15-20 per cent. of its weight of water. Musk is fairly soluble in water and by the above method of treatment, 70 to 75 per cent. of the material goes into solution, leaving behind debris of vegetable and cellular matter. If the solution is heated, a little more musk goes into solution but this was avoided as likely to lead to an escape of the volatile matter contained in the musk.

Action on the Higher Centres:—Musk and similar odourous substances have been used for a long time in the indigenous medicine in India as nerve sedatives in epilepsy, hysteria and convulsions in children. Indeed, in nearly all pharmacopœias, ancient or modern, drugs which are characterised by a very powerful odour have been employed as nerve sedatives. It is very difficult, however, to estimate the real value of these therapeutic agents as their merits cannot be definitely substantiated by experimental proof in the laboratory. Macht and Tung (1921) devised a technique for studying quantitatively the sedative effects of musk and other odourous substances on the central nervous system. A few drops of the solution of the aromatic drug were added to a wad of cotton in the neck of a

funnel, under which rats were confined for about 15 minutes. The rats were then placed in the entrance to a maze and the time of traversal and the number of errors during their passage were noted. It was found that musk produced only a very slight depression of the higher centres, if any at all. In our experiments on animals in the laboratory, there was no evidence to show that musk has a sedative action at all. In doses of 2 grains administered orally in several cases in the hospital, no sedative effect of the drug could be observed.

Action on the Circulatory System:—Intravenous injections of 10 to 20 mgm. of the soluble portion of musk in 1 to 2 c.c. of water, injected into the femoral vein of cats under chloralose anæsthesia do not cause any change in the carotid blood pressure. In higher doses also, very little effect is observed. In isolated hearts of rabbits and kittens perfused by Langendorff's method, watery solutions of musk in concentrations varying from 1 in 1,000 to 1 in 200,000, do not bring about any alteration in the rate, rhythm and force of contraction of the heart. On the amphibian heart, injections of the aqueous solution of musk in the lymph sac or under the skin of frogs do not produce any noticeable change. In isolated heart of frogs also, perfused with frog Ringer solution, no stimulation of the organ is discernible on addition of weak or concentrated solutions of musk. Mudaliar, David and Reddy (1929) have recorded similar observations with tincture of musk obtained from Messrs. Southal Bros. and Barclay Ltd., Birmingham.

Action on the Cellular Elements of the Blood:—According to Mudaliar, David and Reddy (1929) musk has a well-marked effect on the cellular elements of the blood. The total number of leucocytes are said to be increased after oral administration. This effect, according to these workers, is particularly marked in patients who have leucopenia, the total leucocytic count being doubled in some patients after musk, while comparatively little change is produced in normal individuals or in those with leucocytosis. They administered 10 to 20 minims of tincture of musk in an ounce of water and found that within ½ to 1 hour after administration the total leucocyte count showed a definite increase. In order to confirm these observations, the drug was

administered in the wards of the Carmichael Hospital for Tropical Diseases, to healthy individuals as well as in a group of six patients suffering from kala-azar with a marked leucopœnia. Powdered musk in doses of 1 grain was administered to the subjects 2½ hours after food daily for seven consecutive days and regular records were kept of the blood pressure, the rate, volume and tension of the radial pulse ; the total erythrocytic and leucocytic counts were done at the same time. As the counts done soon after musk is given are likely to be fallacious on account of psychic and gastric reflexes set up by the drug, we made observations at least two to three hours after the dose was given. The blood counts were made before and after the administration of musk and again at the end of a period of seven days ; even at this date no appreciable changes were observed in the count. The blood pressure, pulse rate, tension, etc., showed no appreciable changes. In healthy individuals (laboratory assistants) no change in the pulse rate, blood pressure and blood counts could be observed after two grain doses of musk. The subjects, however, stated that they felt a general sensation of well-being in the stomach and that the drug seemed to produce an effect resembling in many ways a dose of carminative mixture which was administered to them with a view to comparing the effects. The results obtained in case of the kala-azar patients were similar to those observed in case of the healthy individuals and no appreciable rise in the leucocyte counts could be observed.

Action on the Respiratory System:—In animals under urethane anæsthesia, injections of 10—20 mgm. of soluble portions of musk in 1 to 2 c.c. of water do not produce any marked change in the intratracheal pressure tracings. When, however, a cotton-wool pledget soaked in musk solution is brought in close proximity to the nose of such an animal, a distinct but very transient stimulation of respiration is noticed. This transient stimulation is also observed when a minute quantity of aqueous solution of musk is gently sprayed by means of a small syringe into the nasal mucous membrane of the anæsthetised animal. The time taken for the stimulation in the latter case, however, is longer than when the musk is brought in

touch with the nose. This is probably due to the fact that odourous substances must be in a volatile state to produce typical odour responses through the olfactory nerve-endings. Musk solutions when sprayed directly into the tracheal mucous membrane through an opening in the tracheal cannula, however, fail to produce the stimulation noticed in case of the direct application of the drug to the nasal mucous membrane. These experiments show that musk has got no special action on the respiratory system. Whatever slight stimulation of respiration is observed is probably entirely reflex brought about by the stimulation of the olfactory nerves of the nasal mucous membrane which carry the impulses *via* the olfactory bulbs and tracts to the higher centres in the hippocampal gyrus. From these areas, the respiratory centre in the medulla is probably stimulated through the conducting fibres passing from the brain to the cord. This seems likely as musk is one of the most powerful of the odourous substances known. Valentin (1903) has estimated that a total of 0.02 mgm. (0,00,000,009 mgm. per litre) can be distinctly smelt by human beings. From this, the strong sensory stimulation which is produced may be easily imagined.

Uses of Musk in Medicine:—Musk has been used by the Hindu physicians for a long time and forms the constituent of a number of preparations. In the 'Bhavaprakasa' three varieties are described, namely Kamrupa, Nepala, Kashmira. The first is described as black and superior to others, and probably consists of China and Tibet musk imported *via* Kamrup. That from Nepal described as being of bluish black in colour, is of intermediate quality, while the Kashmiree musk is inferior to all. The Hindu physicians regard the drug as a cardiac and general stimulant, aphrodisiac, and employ it as an antispasmodic and anodyne in low fevers, chronic cough, general debility and impotence. Its fame as a cardiac stimulant is so great that it is almost the last resort when everything else has failed to support the heart. As a cardiac stimulant, it is prescribed sometimes alone and sometimes in combination with 'makaradhwaja' (insoluble sulphide of mercury) and *Sida cordifolia* (Berela or Bala). It is said to stimulate the brain, the respiratory and vasomotor centres in the medulla, spinal

cord and peripheral nerves. It increases the arterial tension and is said to stimulate the uro-genital organs. The elimination is by the urine, sweat and milk. In low fevers with prostration, anæmia and general debility as a result of chronic ailments it is particularly valued. Its use as an aphrodisiac in sexual impotence has been very much in vogue. Tamil physicians in South India prescribe the remedy in children in cases of convulsions combined with opium ; it has also a reputation of curing dyspepsia and colitis.

Musk was introduced in the Western medicine probably at the latter part of the sixteenth century. Since then, it has been prescribed as a stimulant in many ailments, *e.g.*, typhoid fever, typhus, gout, in lockjaw or tetanus, hydrophobia, epileptiform and hysterical attacks, chorea, whooping cough, hiccough, asthma, colic, etc. Crookshank (1905) spoke well of the drug in acute specific infections resulting in toxic involvement of the central nervous system. He used 5 grains of the powdered musk every 2 hours with satisfactory results. In convulsions of children, where no definite causative factor can be determined, musk has been used with promising results in combination with chloral hydras. Still (1906) recommended a rectal injection of chloral hydras (gr. 5 to gr. 10 according to age) and tincture of musk (10 drops to 30 drops). It has also been used as a cardiac stimulant in cases of failing circulation, and palpitation of the heart under the belief that it raises the blood pressure and improves the character and volume of the pulse. Dr. Mitra of Kashmir (1898) found musk of great value in cardiac asthenia due to plague. He used powdered musk with great benefit. The belief in the efficacy of the drug, however, is gradually changing. Musk was once official in the British Pharmacopœia, but has since been removed. It was official in U.S.P. IX, but has been deleted from U.S.P. X.

Ticture of musk is still very largely used by medical men in India in doses of 10 to 30 minims as a cardiac stimulant, in depressed conditions of the nervous system and as an aphrodisiac. Our own work, both experimental and clinical does not bear out the cardiac-tonic and leucocyte-raising properties attributed to musk. Whatever stimulant effect it might have is probably

reflex from the olfactory nerves on account of its strong smell and from the stomach on account of its slightly irritant effect on the mucous membrane. We have already observed that patients who had received a dose of musk have a feeling of warmth and well being in the stomach and this may reflexly produce slight stimulation of the heart and respiration. There appears to be no foundation for belief in its efficacy in epilepsy, chorea and in convulsions of children. In hysteriform attacks it probably acts in the very much the same way as strong smelling substances such as asafœtida, valerian, etc. In whooping cough and colic, its action probably resembles the drugs of the essential-oil group. From our observations, we have come to the conclusion that the importance of musk in the indigenous medicine in India has been very much over-rated and that it has not got any marked physiological or therapeutic properties.

References :—

(1) Khory, R. N., & Katrak, N. N., 1902, *Materia Medica of India and their Therapeutics;* (2) *Pharmaceutical Journal and Pharmacist,* June 14th; (3) Dixon, 1929, *A Manual of Pharmacology;* (4) Meyer and Gottlieb, 1928, *Experimental Pharmacology;* (5) Mudaliar, David and Reddy, 1929, *Madras Medical Journal,* April; (6) Gerardin, 1927, quoted in *Schimmel's Report,* 1928, p. 123; (7) Macht and Ting, 1921, *Jour. Pharm. and Exper. Therap.,* Vol. XVIII, p. 361; (8) Vallentin, 1903, Quoted in *Bioassays* by Munch, 1931; (9) Chopra and Mukerji, 1932, *Ind. Med. Gaz.,* June.

SILAJIT

Asphalt ; Mineral Pitch.

VERN.—Sans.—*Silajit, Silaras ;* Hind., Guj. & Mar.—*Silajita ;* Beng.—*Silajatu ;* Tam.—*Uerangyum ;* Arab.—*Hajar-ul-musa.*

Silajit is an exudation from rock-surface obtained in certain parts of India during the months of May and June when the weather is very hot. It is found in abundance in the lower Himalayan hills near Hardwar, Simla, and also in Nepal.

Large quantities of it are imported into India from Khatamandu. A white variety is said to be collected from rocks in Mount Abu. It may be mentioned here, however, that alum earth of Nepal which is sold in Calcutta as *white silajit* is quite a different substance from the silajit used in the Hindu materia medica. Four varieties of silajit are described by the ancient Hindu writers: (1) the *gold silajit* which is red ; (2) the *silver silajit* which is white ; (3) the *copper silajit* which is blue coloured ; and (4) *iron silajit* which is blackish brown. Blue and red silajit are not found commonly and the variety mostly available is the fourth variety which, from the therapeutic point of view, is considered to be active. The author's investigations were, therefore, mainly confined to this variety.

Silajit is an important drug of the ancient Hindu materia medica and is extensively used by the Hindu physicians in a variety of diseases. It is said to be efficacious against phthisis, chronic bronchitis and asthma, digestive troubles, renal and bladder calculi, dropsy, nervous diseases, leprosy, diabetes, fracture of bones, etc. It is also used as an antiseptic in parasitic diseases of the skin and as an antiphlogistic. The Mohammedan physicians included it in their materia medica three centuries ago and used it as an antidote to poisons and in the treatment of disease. A similar product called 'Momia' is obtained from some of the mountains in Arabia and Persia and is extensively used by the hakims as an external application for inflammatory swellings, arthritis, etc.

Chemical Composition :—The general appearance of silajit is that of a compact mass of vegetable organic matter composed of a dark-red gummy matrix interspersed with vegetable fibres, sand and earthy matter. The gummy substance dissolves in water and when washed away leaves an earthy matter, vegetable fibres and a few black round button-like masses (1/8 inch in diam.) resembling peas. The insoluble matter is removed by straining through a thick cloth or flannel. The fluid is allowed to stand in the sun when a creamy substance rises to the top. The purified silajit (*shodhita*) is just like the concentrated watery extract of the crude stuff. Both the crude and purified samples have a decided urinous odour and slightly bitter, saline, somewhat pungent and astringent taste. The purified substance is nearly completely soluble in water and has an acid reaction.

Hooper was the first to analyse *silajit* and the results of his analysis are as follows :—

Water ...	... 8.85	Nitrogen	...	1.03
Organic matter	... 56.20	Lime ...	...	7.80
Mineral matter	... 34.95	Potash ...	...	9.07
	100.00	Phosphoric acid	...	0.16

The organic matter yielded to spirit a small percentage of brownish coloured wax-like substance which melted on heating and burnt away with a smoky flame. It retained the peculiar odour of the drug and had no marked taste. It was neutral in reaction and did not assume a crystalline structure when carefully evaporated from alcoholic solution. The tests would indicate the presence of a mineral hydrocarbon of a bituminous nature. The bulk of the dark brown organic matter had the properties of humic acid. The drug, from a chemical point of view, should have some valuable manurial properties.

White Silajit :—A sample of white silajit, which is considered to be more effective than the black variety, was also examined by this worker. It was a cream-coloured crystalline compound with a strong nauseous odour. It was apparently of animal origin and afforded gaseous ammonia when mixed with slaked lime. It yielded 64 per cent. of pure urea when determined from the amount of nitrogen given off by means of hypobromite of sodium. It appeared to be crude urea or evaporated urine in a solid state.

A careful analysis of the ordinary silajit was carried out by the author and his co-workers. It does not contain any compound of the nature of an alkaloid. The following table shows the percentage of dried extracts after distilling off the solvent.

Solvent.	Crude *silajit* amount dissolved in per cent.	Purified *silajit* amount dissolved in per cent.
Chloroform ...	2.15 per cent.	5.88 per cent. (cryst.)
Ethyl acetate ...	1.12 ,, ,,	1.37 ,, ,,
Alcohol (80 per cent.)	29.25 ,, ,, (cryst.)	30.81 ,, ,, (cryst.)
Water ...	22.66 ,, ,,	28.32 ,, ,,

Both the alcoholic extracts crystallised after several days and were found to contain benzoic acid; the ash left after ignition showed the presence of a larger quantity of lime. The crystals under the microscope looked like those of calcium benzoate. The ethyl acetate extract was crystalline in nature. It contained a substance soluble in alcohol and partially soluble in hot water, but practically insoluble in ether and chloroform. The crystals had a melting point of 187°C and were identified by further examination to be those of hippuric acid.

The result of the analysis shows that silajit is composed of the following substances :—

Organic Constituents

	Crude *silajit* per cent.	Purified *silajit* per cent.
Moisture	12.54	29.03
Benzoic acid	6.82	8.58
Hippuric acid	5.53	6.13
Fatty acids	2.01	1.36
Resin and waxy matter ...	3.28	2.44
Gums	15.59	17.32
Albuminoids	19.61	16.12
Vegetable matter, sand, etc.	28.52	2.15

Moisture was determined by drying the substance in the steam oven at a temperature not exceeding 90°C. Albuminoids were calculated from the total nitrogen, determined by Kjeldhal's process (modified) after deducting the percentage of nitrogen in the hippuric acid present

The mineral constituents, as obtained from the ash by incineration of the substance at a dull red heat, are also appended in the following table :—

	Crude *silajit* per cent.	Pure *silajit* per cent.
Moisture	12.54	29.03
Loss on ignition	64.58	52.63
Ash	22.88	18.34
Silica (residue insoluble in HCl) ...	4.60	2.69
Iron (Fe_2O_3)	0.51	0.64
Alumina (Al_2O_3)	2.26	2.61
Lime (CaO)	6.83	4.82
Magnesia (MgO)	1.29	1.20
Potash (K_2O)	4.60	3.81
Sulphuric acid (SO_3)	0.64	0.97
Chloride (NaCl)	0.26	0.57
Phosphoric acid (P_2O_5)	0.28	0.24
Nitrogen	3.64	3.36

From a comparison of the above results, it appears that there is not much difference between the crude and the purified silajit. The crude stuff leaves a residue after extraction with water which amounts to about 30 per cent., whereas the residue in the purified drug is only about ⅔ per cent. This may lead one to suppose that the purified silajit contains more extractives than the crude form. This would have been the case were it not for the fact that the high percentage of moisture in the purified substance counter-balanced the insoluble matter

in the crude stuff. The main point of difference between the varieties is that the chloroform and ethyl acetate extracts of the purified substance deposit crystals of benzoic and hippuric acids, but there are none in similar extracts made from the crude silajit. It would appear, therefore, that a portion of the benzoic and hippuric acids remains free in the purified silajit. Probably the salts of the benzoic and hippuric acids in the crude silajit are hydrolysed during the process of purification.

From the physical characteristics and from a microscopical examination of the residue left after extraction with water, which was mainly composed of sand, earthy matter and vegetable fibres, silajit would appear to be a substance of vegetable origin. Its chemical composition, however, shows the presence of hippuric acid and a high percentage of albuminoids, which makes this supposition doubtful. If hippuric acid is formed from the decomposition and decay of vegetable protein substances without animal intervention, the amount of proteins must be in unusually higher proportions than is ordinarily met with in the vegetable kingdom. It is well-known that benzoic acid can be easily formed from hippuric acid, in fact this is one of the commercial methods of its manufacture. It is further found that benzoic acid manufactured from hippuric acid possesses a decided urinous odour and we have already mentioned that the crude and the purified silajit possess this odour. The presence of gum and resin is also a point in favour of its vegetable origin. The other possibility is that silajit may be composed of the excrements of some animals which have been washed off by the rains from the hill-side and have been deposited in the crevices and low-lying rocks. During the summer the heat of the sun removes the moisture and leaves the residue like an exudation on the rock. The whole of the subject of the production of silajit requires further investigation.

Therapeutic Uses of Silajit :—Of all the remedies used by the Hindu physicians against diabetes, silajit is said to be one of the most efficacious. It is said that 'under its influence thirst, polyuria, burning sensation and exhaustion disappear quickly'. It markedly helps the assimilation of sugar. The Hindu physicians use the drug in combination with milk or

grape juice. Purified silajit is also recommended to be soaked in the decoctions of one or more of the following plants as this is said to increase its efficacy. *Shorea robusta* (sala), *Buchanania latifolia* (piala), *Terminalia tomentosa* (asana), *Acacia farnesiana* (acacia), *Catechu nigrum* (catechu), *Terminalia chebula* (myrobalan), and *Sida cordifolia* (bala).

The author has tried the purified drug by itself in a series of cases of diabetes mellitus in order to see what effect it had in this condition. The patients were selected at random as they came to the hospital for admission. The total carbohydrate intake was fixed and kept strictly under control. The total quantity of urine in 24 hours was carefully collected, measured, and a part of it was examined every day for the quantity of sugar present. The blood sugar was also estimated from time to time. The patients were regularly weighed during the entire period of the trial.

After admission, the patients were put on a strict diet of known carbohydrate value and some time was allowed for the daily output of the sugar to run to a constant level. The patients were then put on increasing doses of silajit (in pill form) till a maximum of 30 grains a day was taken during 24 hours. Careful observations on a series of diabetic patients showed that doses of silajit ranging from 5 grains to 10 grains, three times a day, for a period of 8 to 12 days, had no effect whatever either on the blood sugar or sugar in the urine. There was no decrease in the total quantity of the urine passed, and there was no amelioration of such symptoms as thirst, exhaustion, etc. The assimilation of carbohydrates was not improved in any way. The administration of insulin in these patients, rendered the urine sugar-free and the symptoms such as polyuria, thirst, etc., disappeared.

When applied externally, silajit has been credited with antiseptic, parasiticidal, anodyne and antiphlogistic properties by the Hindu physicians. These are in all probability due to the free benzoic acid which it contains. It is well-known that benzoic acid which in concentrations of over 0.1 per cent. produces moderate local irritation, may in this way be useful as an application to sprained and bruised parts. Benzoic acid

is also responsible for the beneficial action of silajit on the appetite and its use in dyspepsia. Its good effects in affections of the liver such as jaundice, its mild narcotic action, its anti-spasmodic effects in colics of all forms and spasms of muscular tubes and asthma may also be attributed to the presence of this acid and its salts. Silajit is used by the Hindu physicians in acute and chronic bronchitis and benzoic acid and benzoates are administered in these conditions in the Western medicine especially for children and to old feeble persons with profuse thin secretion. It undoubtedly promotes expectoration, probably reflexly, by causing irritation of the throat and stomach. The Vaidyas prescribe the drug in arthritis and pulmonary tuberculosis ; 30 years ago, benzoic acid and its salts enjoyed a reputation in the Western medicine as a remedy for these conditions, but were given up. The indigenous practitioners also used silajit as a diuretic and lithontriptic. Similar properties were attributed to benzoic acid in Western medicine. It will be seen, therefore, that most of the properties ascribed to silajit can be explained by the presence of benzoic acid and benzoates which are present in it in large quantities and which we consider are the main active principles of silajit.

Recently, Ray (1930) has shown that injections of extracts of silajit produce a rise in blood pressure and stimulation of respiration in experimental animals. He thinks that, as benzoic acid and benzoates are known not to have any action on the pulse and blood-pressure, there must be some other active principle in the drug which has not yet been detected by chemical analysis. He suggests that some unknown body or a pyridin derivative might be responsible. The experimental data given by this worker, however, do not appear to justify such a conclusion.

Summary :—A fairly complete chemical analysis of silajit has been made. It contains besides gums, albuminoids, traces of resin and fatty acid, a large quantity of benzoic and hippuric acids and their salts. From the medicinal point of view, the chief active substances in it are benzoic acid and benzoates. The benefits ascribed to it by the Hindu physicians in different

diseases may be attributed to this drug. Silajit has no effect either on the blood sugar or the urine sugar in diabetes.

References :—

(1) Chopra, R. N., Bose, J. P., and Ghosh, N. N., 1926, *Ind. Jour. Med. Res.*, Vol. XIV, p. 145, (2) Ray, P. C., 1930, *Patna Journal of Medicine*, Vol. V, July.

SNAKE VENOM

VERN.—Sans.—*Sarpavisha, Garala.*

The use of snake venom in the Hindu medicine is of comparatively recent origin as references to it are chiefly met with in such modern works as 'Ratnavali', 'Sarkaumudi', etc. Although the venoms of other snakes are mentioned, the venoms of the Indian cobra and Indian viper have been chiefly used.

The Indian cobra—*Naia naia* vel *tripudians*—varies from 150 to 190 cm. in length and has a variable colour but is usually black. The head is generally golden yellow in colour, spotted with yellowish white marks above and pure white beneath. This species is distributed throughout the whole of Southern Asia from the South of the Caspian Sea to South of China, India and the Malay Archipelago. Several varieties of it are met with in India, *Naja tripudians* and *Naja bungarus* being the two formidable varieties.

The Indian vipers.—Two poisonous snakes belonging to this group commonly occur in India. (1) *Daboia russelli* vel *elegans* is about 200 cm. in length and has a beautiful grayish yellow or light brown colour. It may be distinguished by three rows of brown black spots on the body, the outer two rows consisting of spots ringed with white edges. It is found all over the plains of India particularly in Ceylon, Siam, Burma, Rajputana and Bengal. It has been met with in Kulu and Kashmir valleys at an altitude of 5,000 to 6,000 ft. though generally it is an inhabitant of plains and valleys up to 2,000 to 3,000 ft. The reptile is quiet in habit and attacks man only in self-defence or when it is provoked to attack. It produces a terrible hissing sound when in readiness to attack.

(2) *Echis carinata* is another viper which is frequently met with in India. It is found in the North-Western Frontier Province, Baluchistan, the Punjab, Sind, Rajputana, Central India and some parts of Madras and Ceylon. It is 40 to 50 cm. in length and has a brown or brownish-grey colour. The back is marked with two rows of whitish longitudinal zig-zag lines stretching over the whole body. The upper surface of the head exhibits a yellowish rhomboidal spot looking like a cross. The body is covered with imbricated and keeled scales which make a peculiar rustling sound when the reptile moves along.

The poisonous glands of the snakes are situated at the back portion of the upper jaw. The ducts are connected with the fangs. The poison is squeezed out when the snake closes the jaws tightly in the act of biting or swallowing. The venom is only a digestive secretion. Every time the snake swallows the food the poison is swallowed with it and helps in digestion, particularly of proteins.

Physical and Chemical Characteristics:—The venom is obtained by forcing open the jaws and squeezing the glands into a sterile petri dish or by making the reptile bite a petri dish with a rubber membrane stretched over it. When fresh the venom is a clear transparent fluid. It has a faintly acid reaction and its consistence varies from that of water to that of the white of an egg. When dried under a bell jar in the sun or over concentrated sulphuric acid, it loses 50 to 70 per cent. of water and is converted into a yellowish granular mass which can be powdered. The dried venom retains all the properties of the fresh venom. When kept in a liquid state it becomes alkaline with the deposit of a feather-like substance, but when kept in hermetically sealed ampoules in a cool dark place, it retains its potency for a long period.

The venom is composed of variable amounts of proteins, albumoses, pigments, mucus, epithelial debris, fatty matters, salts like chlorides and phosphates of calcium, ammonia and magnesium, analogous to the constituents of normal saliva.

The chemical nature of the venom, however, is very variable and uncertain. It resembles protein in its reactions since it can be precipitated with alcohol, tannins, etc., and does not diffuse through the dialysing membrane. Armand Gautier (1883) believed that the venom

contains an alkaloid, which could be separated out by pulverising the venom with carbonate of soda and systematically extracting the mixture with alcoholic ether at 50°C, but other workers have not succeeded in separating any alkaloid. Mitchel and Reichert (1884) showed that the cobra venom consists of 98 per cent. of albumin and only 2 per cent. of globulin. Viper venom on the other hand consits of nearly 25 per cent. globulins.

According to Martin and Smith (1892) the cobra venom albumoses *can be fractionated into hetero-albumoses, proto-albumoses and deutero-*albumoses, but the albumins contained in it are devoid of all toxic power. Many chemical substances like 1 per cent. solution of potassium permanganate, gold chloride, chloride of lime and even hypochloride of calcium (1 in 12), chromic acid, bromine water, 1 per cent. trichloride of iodine modify or delay the action of venom. There has been much discussion regarding the nature of the toxic principle in the different venoms (1902). According to Faust (1910-11) the chief toxic substances in the cobra and rattle snake venoms are some non-nitrogenous principles. These are not glucosides but otherwise resemble saponins in their physical, chemical and pharmacological properties. They are responsible for its action on the central nervous system. Cobra venom can stand the temperature of 100°C for a short time without losing all its activity. The toxicity of the cobra venom is not modified by filtration through a porcelain candle, while that of viper venom is altered considerably. In this way the non-diffusible albuminoid coagulable at 82°C and diffusible non-coagulable albumose can be separated. The former which produces hæmorrhages has been called *hæmorrhagin* and the latter which acts on the nerve cells of the respiratory centre has been called *neurotoxin*. Most of the colubrin and viperin snake poisons contain the hæmolytic principle. In general it may be said that the first effect of the venom is to produce agglutination of the erythrocytes followed by their solution after a variable interval, which depends on the kind of snake and the potency of the venom. The agglutinating power of the venom is *destroyed at a temperature between 75 to 80°C maintained for 30 minutes.* Different venoms differ in their hæmolytic power. Cobra venom is the most active in this respect and then follow the venoms of water moccassin, copper head, rattle-snake in the order named. Variations in susceptibility to this reaction are present in different animals. Dog's blood is most quickly and easily hæmolysed in high dilutions, while the ox's corpuscles are least susceptible. The intermediate animals are the sheep, guineapig, pig and rabbit, etc. This variation, it is suggested, is due to variation in the lecithin content of the blood. Ox's blood can be hæmolysed even in very high dilutions of the venom in the presence of lecithin. The hæmolytic power of the venom is only slightly effected if the venom is exposed to 100°C for 10 to 15 minutes. Acton and Knowles (1913-14) have shown that most of the venoms consist of (*a*) *hæmorrhagin* which has the property of destroying the endothelial

cells lining the finer blood vessels and of giving rise to ecchymosis and extravasation of blood, (*b*) a *cytolysin* which dissolves both the red and white blood corpuscles, and (*c*) a fibrin ferment which causes an intra- and extra-vascular clotting leading to pulmonary embolism and death from asphyxia and (*d*) a *neurotoxin* which acts on the central nervous system as well as on the nerve endings.

The venom is also said to possess the power of destroying the bactericidal properties of the normal blood sera. Welch and Ewing (1894) explained that the rapid putrefaction which sets in in the animals after poisoning with cobra venom is due to this property. This reduction of the bactericidal power of the normal sera is due to the fixation of the serum complement by the venom. The venom has no action on the intermediary body of the serum. Calmette's antivenin has the restraining action upon the venom hæmolysis and venom bacteriolysis.

Pharmacological Action of Cobra Venom :—It was believed that the action of the cobra and viper venoms was the same and that the divergence of symptoms noticed in the two cases were only due to the difference in the degree of toxicity. It was suggested later that these two venoms have entirely different seats of action. Epstein (1930) studied the action of the South African cobra, *Naia flava* (*Naia vivea*) and found that it produced death by respiratory failure. The venom also has a direct action on the involuntary muscles, contraction being followed by relaxation. Chopra and Iswariah (1931) have made a pharmacological study of the action of the venom of the Indian cobra, *Naia naia* vel *tripudians*. The M.L.D. of the venom varies with the species of the animals; cats and rats are less susceptible; dogs, rabbits and man are more easily affected. When given intravenously the venom produces an immediate effect, the animal dying within a few minutes of respiratory failure provided a large enough dose is given. The absorption is slower when the venom is given by the subcutaneous and intramuscular routes, death taking place in 4 to 24 hours. The venom is not absorbed at all from the gastro-intestinal tract or other mucous membranes. The venom has no effect on the activity of salivary, gastric and pancreatic secretions of man *in vitro*. It slightly increases the tone of the musculature of the gastro-intestinal tract in cats and rabbits.

Injections of sub-lethal doses of the venom produce a small but persistent rise of blood pressure in experimental animals. This rise is not due to any stimulant action on the accelerator mechanism of the heart or on the myocardium. None of the concentrations of the venom, however high or low, produce definite stimulation of the heart especially when it is failing. Very large doses appear to act directly on the heart producing a marked depression and stoppage. The rise of blood pressure appears to be associated with the stimulation of the vaso-motor centre in the medulla as it is absent in decerebrated animals. The fall of blood pressure produced by large doses has been shown to be due to paralysis of the vaso-motor centre. The main action of the

venom in lethal and sub-lethal doses on the animals is on the respiratory centre, the effect being one of initial stimulation and final paralysis. The venom appears to have no effect on the motor end-plates in the diaphragm or other respiratory muscles. Observations on animals show that the venom produce initial stimulation of the higher parts of the brain followed by paralysis. It has been shown by Chopra and Chowhan (1931) that contrary to the general belief the cobra venom has a toxic action on lower organisms such as the *Paramœcium caudatum.*

Pharmacological Action of Daboia Venom :—The venom of Russell's viper produces local abscesses, cellulitis or necrosis of the tissue at the site of the bite. This marked local action is due to large quantities (25 per cent.) of the globulins. The systemic effects are hæmorrhagic effusions in the splanchnic area and ascending paralysis of the central nervous system. The toxicity of daboia venom is reduced to one-third when it is mixed with formaline and incubated for some time. It digests fibrin on account of the presence of fibrin ferment, trypsin. Lamb found that viper venom loses its coagulation power when it is heated to 75 to 80°C. The neurotoxic coagulant substances present in it can be precipitated out with alcohol.

There has been a good deal of divergence of opinion regarding the cause of death with Viper venom. Cunningham (1894) reported that death in the animals' bitten by Indian daboia is due to its direct action on the central nervous system. Martin (1897) believed the cause of death to be intravascular clotting. Later, Lamb and Hanna (1903) working on the Indian daboia also showed that the death was due to extensive intravascular clotting. The minimum lethal dose for the rabbit is found to be 0.26 mgm. per kilogram intravenously. Fowls bitten by this viper die within 30 seconds, dogs in 7 minutes and cats in about an hour; the horses die in about 11½ hours. Acton and Knowles (1914) found the minimum lethal dose to be 0.5 to 2.5 mgm. per 100 gms. of the wild rat, death occurring in 8 to 14 hours. In rabbits and guineapigs when lethal doses were given the action was not so rapid as is the case with cobra venom. The action appears to be mainly local, the venom being fixed locally on account of the clotting action of the blood. In case of wild rats 8 to 9 mgm. intravenously was fatal in 2 to 4 hours in animals weighing 700 gm. The animal at first showed restlessness, breathlessness and then became dyspnœic, asphyxial convulsions and paralysis of the hind limbs following. The death occurs owing to respiratory failure, the heart continuing to beat for some time after the respiration stops. Frogs are least susceptible. Chopra and Chowhan (1932) have shown that the viper venom unlike cobra venom has little or no action on the protozoal organisms. In experimental animals the blood pressure falls with a rise in the volumes of the spleen and intestines and with engorgement of the splanchnic blood vessels; the heart dilates at first and then stops in diastole. The effect of the venom appears to be like that of

histamine. Saline infusions and adrenaline injections revive the animal by increasing the blood volume and constricting the systemic blood vessels.

The pharmacological action of the venom of *Echis carinata* is similar to that of Indian daboia. It is marked by intense local inflammation, severe pain and gangrene at the site of the bite. Hæmorrhages and sero-sanguinous effusions are found in all the serous cavities—pleura, pericardium and peritoneum The blood pressure shows an enormous fall, the reflexes are reduced and finally the heart becomes very feeble and stops in diastole.

Therapeutic Uses of the Venoms :—Snake venom forms the constituent of a number of preparations used by the Hindu physicians. Pills containing cobra venom are used in collapse, chorea, etc. With fresh juice of sugarcane, it is given in the treatment of ascites. It is said to be an irritant to the bowel, has a purgative action and is used as a hepatic stimulant. Certain classes of people in India take small doses of snake venom habitually by the mouth with the idea that it protects them from the effects of poisons and diseases. Snake venoms have been recently used in the Western medicine in the treatment of epilepsy, chorea, black-water fever, hæmophilia, etc. It is said that the pathological effect of any given venom on man varies with the dose injected, and that though large doses may be lethal, small doses may produce beneficial physiological effects. In the treatment of epilepsy, the venom is given in doses of 1/200 gr. by hypodermic injections, three to five such injections being given at eight day's interval, afterwards two more injections of 1/75 gr. at 14 days' interval. If the symptoms do not disappear another dose 1/25 gr. is recommended. The dose and the interval of the administration had to be varied according to the age of the patient and the nature of the injury. Fitzsimons (1929) pointed out that this method of treatment is not free from danger unless the venom is properly prepared by skilled hands.

Spangler (1925) used for non-specific therapy intramuscular injections of the protein of the venom of the rattle snake (crotalin) which contains a peptone and a globulin. He took the degree of eosinophilia produced as a guide to dosage and frequency of administration of the proteins. Usually the highest

rise in the percentage of eosinophils following venom protein injections in doses of 1/400 to 1/50 gr. occurs by the second or third day. In from five to seven days after injection, the eosinophils will usually have dropped to 4 per cent. or less, and the patient may be given another injection. The strength of the dose is not increased if a given strength produces an increase of 8 to 10 per cent. eosinophils by the second or third day after an injection. By continuing the injections the rise of eosinophils gradually becomes less, and finally does not exceed normal limits. The patient is then non-specifically desensitized.

Cobra venom is also said to afford a means of diagnosing cancer—Formachidis test. This test depends upon the activation by cobra venom of the hæmolytic action of serum in the deviation of complement test, and the assertion is that the test occurs only with the serum of persons suffering from malignant disease. Injections of venom of *Viper aspis* are also said to protect animals against fixed virus of rabies.

The experimental work by the author and his co-workers has shown that cobra venom is not absorbed from the gastro-intestinal tract. It is, therefore, difficult to see how the venom given by the mouth can produce the effects it is claimed to produce by the practitioners of indigenous medicine. Besides its irritant effect on the gut, it does not appear to produce any other marked action. As regards the stimulant action of the venom on the circulatory system, it is clear from the experimental data obtained that cobra venom has no direct effect either on the myocardium or on the accelerator nerves in the heart. It undoubtedly produces a small but persistent rise of blood pressure probably on account of its stimulant action on the vasomotor centre in the medulla when it is given intravenously. This effect would not be produced when the drug is given by the mouth. The margin between the stimulant and the paralytic dose of the venom on the medullary centres is too small to warrant the use of the drug by injection. There also appears to be no rational basis for its use in the treatment of epilepsy, chorea, hæmophilia, etc., for which it is given by injection by the practitioners of the Western medicine.

References :—

(1) Calmette, A., 1908, *Venoms, Venomous Animals and Antivenomous Serum-Therapeutics;* (2) Flexner and Noguchi, 1901-5, *Jour. Exp. Med.*, Vol. VI, p. 294; (3) Acton and Knowles, 1914, *Ind. Jour. Med. Res.*, Vol. II, p. 100; (4) Spangler, 1925, *Arch. Int. Med.*, Vol. 36, p. 779; (5) Martindale and Westcott, 1928, *Extra Pharmacopœia*, Vol. I, p. 960; (6) Phisalix, 1928, *Trop. Dis. Bull.*, Vol. 25, p. 732; (7) Fitzsimons, 1929, *Trans. Roy. Soc. Trop. Med. and Hyg.*, Vol. 23, p. 435; (8) Clarke, 1930, *Applied Pharmacology*; (9) Sollmann, 1931, *A Manual of Pharmacology;* (10) Chopra and Iswariah, 1931, *Ind. Jour. Med. Res.*, Vol. XVIII, p. 1103; (12) Chopra and Chowhan, 1932, *Ind. Med. Gaz.*, September; (13) Chopra and Chowhan, 1932, *Ind. Jour. Med. Res.*, Vol. XIX.

PART IV

INDIAN MATERIA MEDICA

One of the greatest difficulties which confront the worker engaged in research on the Indian indigenous drugs is to get authentic information regarding the medicinal plants growing in India. The materia medica of the indigenous systems is derived mainly from vegetable sources and is extensive and heterogenous. In different parts of this vast country many different plants are attributed medicinal properties. Unfortunately the information regarding these is very scattered among the large number of old books and periodicals, the majority of which are out of print and difficult to obtain even in big libraries. Very little original research was done during the first quarter of this century and many of the recent publications on the subject contain data derived from the old literature, which sometimes are not accurate. The author receives letters almost daily from all parts of India and abroad for the supply of information regarding the medicinal properties and uses of flowers, roots, barks, leaves, etc., of plants reputed to have some medicinal property. In spite of the facilities at his disposal, the difficulty of obtaining the authentic information from the scattered literature is very great. The necessity for a work in which all the valuable data could be concisely put so that it could serve as a guide to all those interested in this subject has, therefore, been keenly felt for some time past. With this object in view, the following list of medicinal plants and other materia medica has been compiled after studying all the procurable literature. It is hoped that the data contained therein will be useful to those interested in the Indian indigenous drugs and will facilitate and encourage research in the subject. This will ultimately lead to differentiation between the potent and inert drugs and to an extended use of the more effective of these remedies.

This part has been divided into three sections. The first section deals entirely with drugs of vegetable origin, forming by far the largest majority of the remedies used in the indigenous medicine. This is the most complete list of Indian medicinal plants so far prepared, in as much as it contains several hundred more names than any single publication on the subject. To save space, the botanical descriptions and habitat of plants have been omitted. The list has been alphabetically arranged so that it will be easy for the readers to find the particular drug on which he wants information. Abbreviations have been used to save space and to compress all the matter into a small handy volume ; list of abbreviations used is given for ready reference. The scientific names of the plants and the names of the botanists responsible for the nomenclature are included for the simple reason that different names in many cases have been applied by different botanists to the same plant. Under these circumstances, the mere mention of the name of the plant without the name of the botanist, may give rise to confusion. The natural orders to which these plants belong come next ; when a number of plants belonging to the same genus have been discussed the natural order to which they belong is only given with the first named. Important vernacular names commonly used in the different provinces of India have been given and a separate index has been provided at the end. This will enable the reader to trace the plant if he knows one of the common vernacular names. For want of space it has not been possible to include all the vernacular names. The conditions in which the particular plant is used are briefly given. A special feature, which will not fail to attract attention, is the description of the active principles of the plants as far as they have been worked out. The references to the important published literature concerning different plants from Indian, European and American sources up to 1930, have been included. It is hoped this will greatly enhance the utility of the book to the research workers.

The second section describes the inorganic substances used in the indigenous medicine. It would be observed that most of these products are crude salts or mineral ores, as they occur in

nature. This shows that the art of adopting the metals and metallic compounds for medicinal purposes was not highly developed.

The third section deals with drugs of animal origin in very much the same way as the first section. From the large and varied collection of animal substances employed it would appear that the ancient physicians had some knowledge of the properties of the gland and tissue products that are in use to-day.

For the convenience of the reader other lists have been prepared and added to these sections. Lists of plants containing poisonous principles, such as cyanogenetic glucosides or other products yielding hydrocyanic acid, arsenic, barium, oxalic acid, etc., have been given. Recent work regarding the plant remedies used in the treatment of snake-bite and scorpion-sting has been reviewed. It is hoped that these lists will be useful to workers in different branches of scientific research and will stimulate the collection of further material of scientific or economic interest.

The following literature has been consulted in the preparation of this part:—

*Fleming, J. ... ... 1810 Catalogue of Indian Medicinal Plants and drugs.
*Ainslie, W. ... ... 1813 Materia Medica of Hindoostan.
*Ainslie, W. ... ... 1826 Materia Indica.
*McCosh, J. ... ... 1837 Topography of Assam.
*Lindley ... ... 1838 Flora Medica.
*Butter, D. ... ... 1839 Medical Topography of Oudh.
*Dollard, W. ... ... 1840 Medical Topography of Kumaon and Shore valley.
*Irvine, R. H. ... ... 1841 General Medical Topography of Ajmere.
*O'Shaughnessy ... ... 1842 Bengal Dispensatory.
*Irvine, R. H. ... ... 1848 Materia Medica of Patna.
*Birdwood, G. ... ... 1865 Vegetable Products of Bombay Presidency.
*Waring ... ... 1868 Pharmacopœia of India.
*Baden-Powell ... ... 1868 Punjab Products—2 Vols.
*Stewart, J. L. ... ... 1869 Punjab Plants.
*Mohideen Sheriff ... 1869 Supplement to the Pharmacopœia of India.

Author	Year	Title
*Drury, H. ...	... 1873	Useful Plants of India.
*Roxburgh, W. ...	... 1874	Flora Indica.
*Waring ...	... 1874	Bazar Medicines.
Hooker, J. D. ...	... 1875-97	Flora of British India.
Dutta, U. C. ...	... 1877	Materia Medica of the Hindus.
*Sakharam Arjun ...	... 1879	Catalogue of the Bombay Drugs.
*Flückiger and Hanbury ...	1879	Pharmacographia.
*Bentley and Trimen	... 1880	Medicinal Plants.
*Murray, J. A. ...	... 1881	Plants and Drugs of Sind.
Dymock, W. ...	... 1883	Vegetable Materia Medica of Western India.
Dymock, Warden and Hooper ...	... 1883	Pharmacographia Indica—3 Vols.
Watt, G. ...	... 1889-1904	A Dictionary of the Economic Products of India.
*Mohideen Sheriff	... 1891	Materia Medica of Madras.
*Dey, Kanai Lal ...	... 1896	Indigenous Drugs of India.
	1901-16	Proceedings of the Central Indigenous Drugs Committee.
Bose, K. C. ...	... 1902	Official Drugs of India.
*Prain, D. ...	... 1903	Bengal Plants.
Khory, R. N. and Khatrak, N. N. ...	... 1903	Materia Medica of India and their Therapeutics.
Watt, G. ...	... 1904	Commercial Products of India.
Sen Gupta, N. N.	... 1911	Ayurvedic System of Medicine.
Stuart, G. A. ...	... 1911	Chinese Materia Medica.
Rama Rao, M. ...	... 1914	Flowering Plants of Travancore.
Kirtikar, K. R. and Basu, B. D. ...	... 1916	Indian Medicinal Plants.
Gupta, B. C. ...	... 1917	Banausadhi Darpana.
Attygalle, J. ...	... 1917	Sinhalese Materia Medica.
Birdwood, G. T. ...	... 1920	Practical Bazar Medicines.
Henry, T. A. ...	... 1924	The Plant Alkaloids.
Parry, E. J. ...	... 1924	The Chemistry of Essential Oils and Artificial Perfumes.
	1924	Report of the Indigenous Drugs Committee of Madras, I & II.
Nandkarni, K. M.	... 1927	Indian Materia Medica.
Finnemore, E. ...	... 1928	The Essential Oils.
Dutt, N. B. ...	... 1928	Commercial Drugs of India.
Chopra, R. N. and Chandler, A. C.	... 1928	Anthelmintics and their Uses in Medical and Veterinary Practice.
Allen ...	... 1930	Commercial Organic Analysis.

Rosenthaler, L. ... ... 1930 The Chemical Investigation of Plants.

Wehmer, C. ... ... 1930 Die Pflanzenstoffe.

Mohan, B. S. ... ... 1930 Medicinal Drugs of India.

1931 Report of the Drugs Enquiry Committee.

Bal, S. N. ... ... 1932 Catalogue of Medicinal Plant Exhibits in the Indian Museum.

Bose, K. C. ... ... 1932 Pharmacopœia Indica.

Roberts, E. ... ... 1932 Vegetable Drugs of India and Ceylon.

N.B.—The books marked with an 'asterisk' are not easily available.

List of Journals and Books with the Abbreviations Used

Agri. Jr. Ind. ... ... Agricultural Journal of India.

Agri. Ledger ... ... Agricultural Ledger (Govt. of India).

Amer. Chem. Jr. ... ... American Chemical Journal.

Amer. Jr. Pharm. ... ... American Journal of Pharmacy.

Analyst ... ... Analyst.

Ann. Bot. ... ... Annals of Botany.

Ann. Chem. ... ... Annalen der Chemie.

Ann. Chim. ... ... Annales de Chemie.

Ann. Chim. Appl. ... Annales de Chimie analytique appliquée.

Ann. Chim. Phys. ... Annales de Chimie et de Physique.

Ann. Inst. Past. ... ... Annales de l'Institut Pasteur.

Ann. Jard. Bot. Buitenzorg Annales Jardin Botanique Buitenzorg.

Ann. Report Ind. Museum Annual Report of the Indian Museum.

Apoth. Ver. ... ... Apotheker Verein.

Apoth. Ztg. ... ... Apotheker-Zeitung.

Arch. de Pharm. ... ... Archiv de Pharmacie.

Arch. Exper. Path. Pharm. Archiv für experimentelle Pathologie und Pharmakologie.

Arch. Hyg. ... ... Archiv für Hygiene.

Arch. Pharm. ... ... Archiv der Pharmazie.

Ayur. Med. ... ... Āyurvedic Medicine (N. Sen).

Beng. Disp. ... ... Bengal Dispensatory (O'Shaughnessy).

Ber. ... ... Berichte der Deutschen Chemischen Gesellschaft.

Ber. Bot. Ges. ... ... Berichte der Doutschen Botanischen Gesellschaft.

Ber. Pharm. Ges. ... ... Berichte der Deutschen Pharmazeutischen Gesellschaft.

Biochem. d. Pflzen. ...	Biochemie der Pflanzen.
Biochem. Jr.	Biochemical Journal.
Biochem. Ztscher.	Biochemische Zeitschrift.
B. M. J.	British Medical Journal.
Buchn. Repert. Pharm. ...	Repertorium der Pharmacie (Buchner).
Bull. Acad. Roumaine. ...	Bulletin de la Section Scientifique de l'Académie Roumaine.
Bull. Acad. St. Petersbg. ...	Bulletin de l'Académie Impériale des Sciences St. Petersbourg.
Bull. Bot. Gard. Kew. ...	Bulletin Botanical Garden Kew.
Bull. Dept. Agri. Indes Neerl.	Bulletin de Département de l'Agriculture aux Indes Néerlandaises, Buitenzorg.
Bull. Imp. Inst.	Bulletin of the Imperial Institute London.
Bull. Inst. Bot. Buitenzorg.	Bulletin de l'Institut Botanique de Buitenzorg.
Bull. Jard. Bot. Buitenzorg.	Bulletin de Jardin (de l'Institute) Botanique de Buitenzorg.
Bull. Sc. Pharm.	Bulletin des Sciences Pharmacologiques.
Bull. Soc. Chim.	Bulletin de la Société Chimique de France.
Bull. Soc. Chim. Biol. ...	*Bulletin de la Société de Chimie biologique.*
C. C.	Chemisches Centralblatt.
Centralblat Agri. Chem. ...	Centralblatt für Agriculturchemie.
Chem. & Drug.	Chemist and Druggist.
Chem. News	Chemical News and Journal of Physical Science.
Chem. Weekbl.	Chemisches Weekblad.
Chem. Ztg.	Chemiker-Zeitung.
Chin. Jr. Physiol.	Chinese Journal of Physiology.
Compt. Rend.	Comptes rendus hebd. des Séances de l'Académie des Sciences.
Comp. Soc. Biol.	Comptes rendus hebd. des Séances de la Société de Biologie.
Gaz. Chim. Ital.	Gazetta Chimica Italiana.
Helv. Chim. Act.	Helvetica Chimica Acta.
Ind. For. Rec.	Indian Forest Records (and Bulletins), Dehra Dun.
Ind. For.	Indian Forester.
Ind. Jr. Med. & Phys. Sc. ...	Indian Journal of Medical and Physical Science.
I J. M. R.	Indian Journal of Medical Research.
I. M. G.	Indian Medical Gazette.
I. M. J.	Indian Medical Journal.
J. C. S.	Journal of the Chemical Society, London.

Jr. Agri. Res. ...	... Journal of Agricultural Research.
Jahrb. Prakt. Pharm.	... Jahrbuch für Praktische Pharmazie.
Jr. Amer. Pharm. Assoc.	... Journal of the American Pharmaceutical Association.
Jr. Amer. Chem. Soc.	... Journal of the American Chemical Society.
Jr. Assoc. Agri. Chem.	... Journal of the Association of Official Agricultural Chemists.
Jr. Biol. Chem. ...	... Journal of Biological Chemistry.
Jr. Pharm. ...	... Journal der Pharmacie für Aerzte.
Jr. Ind. C.S. ...	... Journal of the Indian Chemical Society.
Jr. Ind. Inst. Sci.	... Journal of the Indian Institute of Science, Bangalore.
Jr. Pharm. Chim. ...	... Journal de Pharmacie et de Chimie.
Jr. Pharm. Soc. Japan.	... Journal of the Pharmaceutical Society of Japan.
Jr. Pharm. Exp. Therap. ...	Journal of Pharmacology and Experimental Therapeutics.
Jr. Physiol. ...	... Journal of Physiology.
Jr. Pract. Chem. ...	... Journal für Praktische Chemie.
Jr. Russ. Phys. Chem. Ges.	Journal der Russischen Physikalisch-Chemischen Gesellschaft.
Jr. Soc. Chem. Ind.	... Journal of the Society of Chemical Industry.
Kew Bull. ...	... Kew Bulletin.
Lancet.	... Lancet.
Meded. Lands. Plantent. ...	Mededeelingen uit s'Lands Plantentuin Buitenzorg.
Monatsh Chem. ...	... Manatshefte für Chemie.
Nederl. Tijdschrft. Pharm.	Nederlandsch Tijdschrift voor Pharmacie Chemie en Toxicologie.
Oesterr. Apoth. Ver.	... Oesterreichischer Apotheker Verein.
Perf. Rec. ...	... Perfume Records.
Pharm. Centralh. ...	... Pharmaceutische Centralhalle.
Pharm. Ind. ...	... Pharmacographica Indica (Dymock).
Pharm. Jr. ...	... Pharmaceutical Journal and Pharmacist.
Pharm. Jr. Trans. ...	.. Pharmaceutical Journal and Transactions.
Pharm. Post. ...	... Pharmaceutische Post.
Pharm. Rev. ...	... Pharmaceutical Review.
Pharm. Weekbl. ...	... Pharmazeutische Weekblad.
Pharm. Ztg. ...	... Pharmazeutische Zeitung.
Pharm. Ztschrft. f. Russl. ...	Pharmazetische zitschrift für Russland.
Phil. Jr. Sci. ...	... Philippine Journal of Science.
Physiol. Abst. ...	... Physiological Abstracts.
Pharmacogn. ...	... Pharmacognosie.

Proc. Chem. Soc. ...	... Proceedings of the Chemical Society, London.
Proc. Roy. Soc. Lond.	... Proceedings of the Royal Society, London.
Punj. Plants ...	... Punjab Plants (Stewart).
Rec. Bot. Surv. Ind.	... Records of the Botanical Survey of India.
S.-Ber. Dorpat. Naturf. Ges.	Sitzungsberichte Dorpat Naturforscher Gesellschaft.
Schim. Ber. ...	... Schimmel Berichte.
Veg. Prod. Bombay	... Vegetable Products of Bombay (Birdwood).
Z. Oesterr. Apoth. Ver.	... Zeitschrift des allgemeinen Oesterreichischen Apotheker-Verein.
Z. Physiol. Chem.	... Zeitschrift für Physiologische Chemie.

ABBREVIATIONS

The following are the abbreviations used:—

Abortif. ... abortifacient.
Absorb. ... absorbent.
Afgh. ... Afghanistan.
Alk. ... alkaloid.
Alter. ... alterative.
Amenor. ... amenorrhœa.
Amorph. ... amorphous.
Antibil. ... antibilious.
Anthelm. ... anthelmintic.
Antid. ... antidote.
Antidysen. ... antidysenteric.
Antilith. ... antilithic.
Antimal. ... antimalarial.
Antiper. ... antiperiodic.
Antiphlegm. ... antiphlegmatic.
Antiphl. ... antiphlogistic.
Antipyr. ... antipyretic.
Antiscor. ... antiscorbutic.
Antisep. ... antiseptic.
Antisp. ... antispasmodic.
Antisyp. ... antisyphilitic.
Aper. ... aperient.
Aphrodis. ... aphrodisiac.
Arab. ... Arabic.
Arom. ... aromatic.
Astrin. ... astringent.
B. ... Bengal.
Bo. ... Bombay Presidency.
Broncht. ... bronchitis.
Burm. ... Burma.
Carmin. ... carminative.
Catar. ... catarrhal.
Cath. ... cathartic.
Cholag. ... cholagogue.
Chr. ... chronic.
Constip. ... constipation.
C. P. ... Central Provinces.
Dec. ... Deccan.
Decoct. ... decoction.
Demulc. ... demulcent.
Deod. ... deodorant.
Diaphor. ... diaphoretic.
Diar. ... diarrhœa.
Digest. ... digestive.
Diur. ... diuretic.
Dysen. ... dysentery.
Dysmen. ... dysmenorrhœa.
Dyspep. ... dyspepsia.
Emmen. ... emmenagogue.
Emol. ... emollient.
Essen. oil ... essential oil.
Expect. ... expectorant.
Febge. ... febrifuge.
Galact. ... galactagogue.
Glucd. ... glucoside.
Gonor. ... gonorrhœa.
H. ... Hindi.
Hæmat. ... hæmaturia.
Hæmor. ... hæmorrhage.
Ind. Baz. ... Indian Bazars.
Indign. ... indigestion.
Inflam. ... inflammation.
Irrit. ... irritant.
Kan. ... Kanarese.
Kash. ... Kashmir.
Lactag. ... lactagogue.
Laxt. ... laxative.
Leucor. ... leucorrhœa.
M. ... Madras Presidency.
Mal. ... Malayalam.
Mat. Med. ... materia medica.
Menor. ... menorrhaagia.
Mucil. ... mucilage.
Nep. ... Nepal.
Nutri. ... nutritious.
P. ... Punjab.
Pers. ... Persian.
Phlegm. ... phlegmatic.
Purg. ... purgative.
Ref. ... reference.
Refrig. ... refrigerant.
Resolv. ... resolvent.
Restor. ... restorative.
Rheum. ... rheumatic.
Rubft. ... rubefacient.
S. ... Sanskrit.
Santh. ... Santhal.
Sialog. ... sialogogue.
Sing. ... Singhalese.
Stim. ... stimulant.
Stomch. ... stomachic.
Subst. ... substitute.
Syn. ... synonym.
Tann. ... tannin.
Tox. ... toxic.
U. P. ... United Provinces.
Var. ... variety.
Vern. ... vernacular.
Vet. ... veterinary.
Vesic. ... vesicant.

SECTION I.

INDIAN MEDICINAL PLANTS

Their vernacular names, uses in the indigenous medicine, chemical compositions and references.

(* Drugs discussed in the text. † Important drugs whose investigation is likely to be useful.)

Abelmoschus esculentus W. & A.; Malvaceæ; see HIBISCUS ESCULENTUS Linn.

A. moschatus Mœnch.; see HIBISCUS ABELMOSCHUS Linn.

Abies excelsa DC.; Coniferæ; stim., rubft.; essen. oil 0.56%, bitter substance, glucd. coniferin; Schim. Ber., 1892, Oct., 21; 1906, April, 32; Arch. Pharm., 1893, 290; 1900, 411; Jr. Pract. Chem., 1865, 243.†

A. webbiana Lindl. (S., H. & B.-Talisapatra); leaves—carmin., expect., stomch., tonic, astrin., used in asthma, broncht. etc.; essen. oil; Schim. Ber., 1922, 5; 1923, 3; Ind. For. Rec., 1922, 368.

Abroma augusta Linn.; Sterculiaceæ; (H. & B.-Ulatkambal, Bo.-Olaktambol); root bark—emmen., in dysmen.*

Abrus precatorius Linn.; Leguminosæ; (S. & Bo.-Gunja, H.-Gaungchi, B.-Kunch, M.-Gundumani); seeds—purg., emetic, tonic, aphrodis., used in nervous disorder and cattle poisoning; abrin, glucd.; Ber., 1903, 1142 and 3003.*

Abutilon asiaticum G. Don.; Malvaceæ; (H.-Kangahi, B.-Petári, Bo.-Kangori, M.-Tutti); leaves—applied to ulcers, internally for stone in the bladder and as an eye wash.

A. avicennæ Gærtn.; (S.-Jayá, Bo.-Nahani khapát); bark—astrin.

A. graveolens W. & A. (H. & B.-Barkanghi, M.-Tutti); diur.; mucil., asparagin.

A. indicum G. Don. (H.-Kanghi, B.-Potári, Bo.-Kangori, M.-Perun-tutti); leaves—demulc., bark—astrin., diur., roots—in fevers, seeds—laxt., demulc.; mucil., asparagin; Pharm. Ind., Vol. I, p. 209; Der. Pflanzer, 1909, 8.

Acacia arabica Willd.; Leguminosæ; (H.-Kikar, B.-Babla, Bo.-Bábhula, M.-Karu velum); gum—in diar., dysen., bark—astrin.

A. catechu Willd. (S.-Khadira, H.-Khair, Bo.-Khaderi, M.-Wothalay); astrin.; catechin, tann.; Proc. Chem. Soc., 1902, 139; 1904, 171; 1905, 398.

A. concinna DC. (S.-Saptalá, H.-Rithá, B.-Bon-rithá, M.-Shika): aper., expect., emetic; saponin, alk.; Arch. Pharm., 1905, 247.

A. farnesiana Willd. (S.-Arimaedah, H.-Gand-babul, B.-Guya-bábulá, M.-Pikharu-vil); astrin., demulc.; essen. oil; Schim. Ber., 1901, April, 16; 1903, April, 16; 1904, April, 21.

A. ferruginea DC. (Nep.-Khour, Berar.-Sonkhair, M.-Shimai-Velvelam); bark—astrin.

A. intsia Willd.

A. jacquemontii Benth. (P.-Kinkar, Bo.-Rátobával); gum.

A. leucophlæa Willd. (S.-Shvéta-barbura, H.-Safed kikar, B.-Safed Bábul); bark—astrin.

A. modesta Wall. (P.-Phulahi, Bo.-Kántosariyo); gum—restor.

A. pennata Willd. (H.-Biswul, Kumaon.-Agla, Nep.-Arfu); leave—in indign., bleeding gums, antid. for snake-poison.

Acacia pycnantha Bth.
A. senegal Willd. (Bo.-Khor, Rajputana.-Kumta); gum—demulc., emol., in inflam. of intestinal mucosa.
Acalypha fruticosa Forsk.; Euphorbiaceæ; (M.-Sinni-marum, Chinni-ka jhar, Chinni); leaves—stomch., in dyspep.
A. hispida Burm; (M.-Watta-tali); flowers—in diar.
A. indica Linn. (S.-Arittamunjayrie, H.-Khokali, B.-Muktajuri); emetic, subst. for senega, in broncht. and snake-bite; acalyphine; Pharm. Ind., Vol. III, p. 293.†
A. paniculata Miquel.; properties same as A. INDICA.
Acampe papillosa Lindl.; Orchideæ.
Acanthus ilicifolius Linn.; Acanthaceæ; (S.-Harikusa, H. & B.-Harcuch kanta); expect., nerve tonic, used in asthma and snake-bite.
Acer pictum Thunb., Sapindaceæ (P.-Kanzal, U. P.-Kanchli); leaves—irrit.
Achillea millefolium Linn.; Compositæ; (Bo.-Rojmari, Ind. Baz.-Biranjasif); stim., tonic; essen. oil, HCN- glucd. achillein; Arch. Pharm., 1846, 58; 1925, 561 (C.C. 1926, I. 2593); Helv. Chim. Act., 1928, 258; Schim. Ber., 1929, 88.†
Achras sapota Linn.; Sapotaceæ; (H. & B.-Sapotá, Bo.-Chikali, M.-Shimai-eluppai); tonic, febge., diur., glucd. sapotin, alk.; Amer. Chem. Jr., 1891, 572.
Achyranthes aspera Linn.; Amarantaceæ; (H.-Latjirá, B.-Apáng, M.-Ná-yurivi); purg., diur., in dropsy and snake-bite; Chem. News, 1891, 147; Pharm. Jr. 1888, 946.†
Aconitum balfourii Stapf.; Ranunculaceæ; (Nep.-Gobari); pseudaconitine 0.4%; J. C. S. 1928, 1105.
A. chasmanthum Stapf. (Kash.-Banbalnag); subst. for A. NAPELLUS; alk. indaconitine 4.3%; I. J. M. R., 1928, 873.
A. deinorrhizum Stapf. (Mohra, Maurabikh); poisonous; pseudaconitine 0.86%; I. J. M.R., 1928, 873.
A. falconeri Stapf. (Bis, Bikh, Meetha-tellia); poisonous.
A. ferox Wall. (S.-Visha, H. & B.-Bish, Bo.-Vachnag, M.-Vashanavi); tox. alk., pseudaconitine; I. J. M. R., 1928, 873.*
A. heterophyllum Wall. (S.-Ativisha, H.-Atis, B.-Ataicha, M.-Ati vadayam); root—antiper., aphrodis., astrin., tonic; amorph. alk. atisine; J. C. S., 1896, 1518.*
A. laciniatum Stapf. (Kalo bikhmo).
A. lycoctonum Linn.; alk. lycoctonine; Arch. Pharm., 1913, 8.
A. napellus Linn. (S.-Visha, H.-Mithazahar, B.-Katbish); alk., aconitine; I. J. M. R., 1928, 873.*
A. palmatum Don. (H.-Biklima, Bo.-Wakhma); in diar. and rheum.
A. soongaricum Stapf.
A. spicatum Stapf. (Bikh, Kalo bikhoma donghi); toxic alk. bichaconitine; Arch. Exper. Pharm., 1925, 131; Proc. Roy. Soc. Lond., 1905, 468; J. C. S., 1905, 1620.
Acorus calamus Linn.; Aroideæ; (H. & B.-Bach, Bo.-Vaj, M.-Vashambu); emetic, stomch., nerve tonic, in snake-bite; glucd. acorin; Ber., 1888, 1912; alk.; Arch. Pharm., 1886, 465; essan. oil; Ber., 1901, 1021; 1902, 3187 & 3195; Schim. Ber., 1916, 8; Jr. Amer. C. S., 1915, 2387.*†
Acronychia laurifolia Blume.; Rutaceæ; (Sing.-Akenda); bark—in ulcers; essen. oil; Pharm. Centralh., 1889, 659; Schim. Ber., 1912, April, 22.
Actæa acuminata Wall.; Ranunculaceæ; O'Shaughnessy, Beng. Disp.
A. racemosa.; nerve sedative, in chr. rheum.; O'Shaughnessy, Beng. Disp.
A. spicata Linn.; nerve sedative, in snake-bite.
Actinodaphne dichotoma Forsk.; Laurineæ; (H.-Morpankhi, Bo.-Mayursikha); anthelm., styptic.

Actinodaphne hookeri Meissn. (Bo.-Pisa); leaves—in urinary disorders, seed oil—used in sprains; alk. actinodaphnine; Jr. Ind. C.S., 1932.
Actinopteris dichotoma Bedd.; Tribe-Asplenieæ; (H.-Morpankhi); styptic, anthelm.
Adansonia digitata Linn.; Malvaceæ; (H.-Gorakh-amli, M.-Paparapuli); pulp—aper., demulc., in dysen.; adansonin; Jahrb. Prakt. Pharm., 24, 100, 242; Jr. Soc. Chem. Ind., 1913, 778.
Adenanthera pavonina Linn.; Leguminosæ; (B.-Rakta-kambal, Bo.-Thorligunj, M.-Anai-gundumani); bark—in rheum., hæmat.; seeds—for boils, inflam.
Adhatoda vasica Nees.; Acanthaceæ; (S.-Vasaka, H. & B.-Adulsa, B.-Bakas, M.-Adhatodai); in chr. broncht., asthma, phthisis; vasicine; Jr. Ind. C. S., 1925, 315; 1927, 541.*
Adiantum capillus-veneris Linn.; Tribe-Pterideæ; (H.-Hansraj, Kash.-Dúmtúli); expect., diur., emmen.
A. caudatum Linn. (S.-Mayúrashikhá, P.-Adhsarita-ka-jari); for skin diseases and diabetes.
A. lunulatum Burm. (H. & B.-Káli-jhánt, Bo.-Hansráj); in fever and erysipelas.
A. pedatum Linn.; in chr. catarrh.
A. venustum Don. (H.-Hansráj, Bo.-Mubárak); resolv., expect., diur., emmen., in scorpion-sting.
Adina cordifolia Hook.; Rubiaceæ; (S.-Dhárákadamba, H.-Hardu, B.-Keli kadam, M.-Manja kadambe); febge., antisep.; bitter principle.
Adonis æstivalis Linn.; Ranunculaceæ; glucd.; Arch. Pharm., 1896, 452.
Ægle marmelos Corr.; Rutaceæ; (S.-Sriphal, H., B. & Bo.-Bael); marmelosin; in diar., dysen.; Jr. Ind. C. S., 1930, 759.*†
Ærua lanata Juss.; Amarantaceæ; (S.-Astmabayda, H. & B.-Chaya, M.-Sirru-pulay-vavr); anthelm., diur.; Apoth. Ztg., 1895, 346.
Æsculus hippocastanum Linn.; Sapindaceæ; (P.-Pú); antiper.; saponin; Compt. Rend., 1907, 1431; Monatsh. Chem., 1910, 657; Bull. Sc. Pharm., 1918, 65.†
A. indica Hiern. (H. & P.-Kanor, Kash.-Hanudún); fruits given to horses in colic.
Aganosma calycina A. DC.; Apocynaceæ; (S.-Málati); in biliousness.
A. caryophyllata G. Don. (S., H. & B.-Málati); tonic.
Agaricus albus. (H.-Chhattri, P.-Kiain); astrin., cath., resin— agaricin used in phthisis, diur., expect.; Stewart, Punj. Plants.
A. campestris Linn. (S.-Chattrak, Bo.-Alombe); tonic.
A. igniarius. (Kash.-Bulgar jangli, P.-Kiain); tonic.
A. ostreatus Jacq. (Cutch & Bo.-Phanasa-alambé); in excessive salivation and stomatitis.
Agati grandiflora Desv.; Leguminosæ; see SESBANIA GRANDIFLORA, Pers.
Agave americana Linn.; Amaryllideæ; (H.-Kantala, B.-Jungli anárásh); roots—diur., antisyp., sap—laxt., emmen., useful in scurvy; saponins; Dragendorff-Heilpflanzen, 1898, 134.†
A. vivipara Linn. (S.-Kantala, H.-Khetki, M.-Kathalai); used in contusions of draught cattle.
Ageratum conyzoides Linn.; Compositæ; (Bo.-Osadi); antilith.; essen. oil; Schim. Ber., 1915, April, 7; Jr. Ind. C. S., 1925, 273.
Aglaia roxburghiana Miq.; Meliaceæ; (S., H. & B.-Priyangu); fruits—cooling, astrin., in leprosy.
Agrimonia eupatorium Linn.; Rosaceæ; arom., astrin., anthelm., diur.; essen. oil; Dragendorff, Heilpflanzen, 280.
Agropyron repens Beauv.; Gramineæ; glucd.; Compt. Rend. 1897, 797.
Ailantus excelsa Roxb.; Simarubeæ; (H.-Mahanimb, M.-Peru-maram); carmin., tonic; ailantic acid; Hooper, Pharm. Jr., 1895, 345.

Ailantus glandulosa Desf.; bark—anthelm., in dysen.; bitter substance; Monatsh. Chem., 1927, 479.
A. malabarica DC. (Bo.-Guggula-dhup, M.-Maddi-pál); carmin., febge., in dysen., snake-bite; quassin, ailantic acid; Pharm. Jr., 1895, 345.
Ajuga bracteosa Wall.; Labiatæ; (Kumaon.-Ratpatha, P.-Khurbanri); bitter, astrin., subst. for cinchona, diur., aper.
Alangium lamarckii Thwaites.; Cornaceæ; (S.-Ankota, H.-Akola, B.-Akar kanta, Bo.-Ankola, M.-Alangi); root—laxt., anthelm., fruit—tonic, in leprosy; amorph. alk. alangine; C. C. 1893, 399.*
Albizzia amara Boivin.; Leguminosæ; (S.-Krishna sirish, Bo.-Lulai, M.-Thuringi); in inflam. and ulcers; saponin; Dragendorff, Heilpflanzen 289.
A. julibrissin Durazz. (H.-Lal siris); in sanke-bite.
A. lebbek Benth. (S.-Pit shirish, H.-Siris, Bo.-Motha siras, M.-Kot vaghe); in snake-bite and scorpion-sting; saponin.
A. odoratissima Benth. (H., B. & Bo.-Siris, M.-Kar vaghe); cures night blindness, tonic.
A. procera Benth. (H.-Safed siris, B.-Kori, Bo.-Kinai tihiri, M.-Konda vaghe); for gums.
A. stipulata Boivin. (H.-Siran, B.-Chakua, Bo.-Udala, M.-Kat turanji); for gums.
Aleurites moluccana Willd.; Euphorbiaceæ; (S.-Akshota, H.-Akhrot, B.-Jangli akhrot, M.-Nattu-akróta-kottai); oil of seeds—purg.
Alhagi camelorum Fisch.; Leguminosæ; (Pers.-Khar-i-buz); laxt., diur., expect.; Hooper, Pharm. Jr., 1912, 35.
A. maurorum Desv. (S.-Duralabha, H.-Jawása, B.-Dulal-labhá); laxt., diur., expect.; manna; J. C. S., 1885, 943; Jr. Amer. C. S., 1918, 1456.
Allamanda cathartica Linn.; Apocynaceæ; (Bo.-Jahari sontakká); cath.; alk., glucd.; Pharm. Ind., Vol. II, p. 418.
Allium ampeloprasum Linn.; Liliaceæ; bulbs used to hasten suppuration of boils.
A. ascalonicum Linn.; (H.-Ek-kanda-lasun, B.-Gundhun); aphrodis., in earache.
A. cepa, Linn. (S.-Palándu, H.-Piyaz, B.-Piyaj); diur., expect., aphrodis., emmen.; essen. oil and organic sulphides; Pharm. Ztg., 1903, 315; Schim. Ber., 1889, April, 44; Arch. Pharm., 1892, 434.
A. leptophyllum Wall.; Himalayan onion; bulbs—sudorific.
A. macleani Baker. (Ind. Baz.-Badsah salap).
A. porrum Linn.; (B.-Paru, Arab.-Kirath); contains As; Compt. Rend., 1903, 202.
A. sativum Linn. (S.-Lasuna, H. & Bo.-Lasan, B.-Rasun, M.-Vallai-púndu); in leprosy, rheum., anthelm.; essen. oil 0.25% and organic sulphides; Pharm. Ind., Vol. III, p. 490; Arch. Pharm., 1892, 434.*
Alnus nepalensis D. Don.; Cupuliferæ; (H. & Nep.-Udis, P.-Kohi).
A. nitida Endl. (P.-Saroli, Kumaon.-Paya).
Alocasia indica Schott.; Aroideæ; (S.-Manaka, H.-Mánkanda, B.-Mankachu); leaves—styptic, astrin., tuber—in piles, constip., anasarca.
A. macrorrhiza Schott.; in scorpion-sting.
Aloe abyssinica Lam.; Liliaceæ; leaves—emol.; aloin 13.6%; Arch. Pharm., 1905, 399.
A. indica Royle.; emmen., anthelm., in chr. ulcers.
A. littoralis Koening.; laxt., tonic, in spleen affections.
A. perryi Baker.; stomch., tonic, purg., useful in dyspep., jaundice, amenor.; barbaloin, socaloin; Ber., 1870, 1604; Pharm. Jr. 1871, 193.
A. spicata Thunb.; (Birdwood, Veg. Prod. Bombay).
A. succotrina Lam.; aloin, barbaloin; Ber., 1875, 1600; Compt. Rend., 1914, 185, 1189.

Aloe vera Linn. (S. & B.-Ghrita kumari, H.-Ghi kanvar, M.-Kattalai); fresh juice—cath., cooling, useful in fevers; pulp—on uterus; root—in colic; aloin, isobarbaloin, emodin; Arch. Pharm., 1898, 200; Bull. Soc. Chim., 1899, 668; 1900, 787; Arch. Pharm., 1903, 346.*
Alpinia allughas Roscoe.; Scitamineæ; (B.-Taro).
A. calcarata Roxb.; subst. for Galanga.
A. galanga Willd. (H.-Bara kulinjan, B.-Sugandha-vacha, M.-Pera-rattai); stomch., stim., carmin., used in flavouring agent; essen. oil; Schim. Ber., 1910, Oct., 138; 1911, April, 19.*
A. khulanjan M. Sheriff. (Khulanjan); stim., carmin., stomch., expect.; essen. oil; Schim. Ber., 1890, April, 21; Pharm. Jr. Trans., 1884, 208.
A. nutans Roscoe. (B.-Punnag champa); use same as Galanga; essen. oil; Schim. Ber., 1899, April, 53; Jr. Soc. Chem. Ind., 1917, 995.
A. officinarum Hance.; (H.-Kulinjan, B.-Sugandha bacha); stomch., stim., carmin.; galangin; Pharm. Jr. Trans., 1884, 208; essen. oil; Schim. Ber., 1890, April, 21.
Alstonia scholaris R. Br.; Apocynaceæ; (S.-Sapta parna, H.-Chatiun, B.-Chhatim, M.-Edakula-pala); in snake-bite; echitenine, ditamine, echitamine; J. C. S., 1925, 1640.*
A. spectabilis R. Br.; alks. alstonamine, ditamine, echitamine, echitenine; Ann. Chem. 1880, 144; 1886, 253.
A. venenatus Brown.; (S.-Rajaadana, M.-Pazhamunnipala); ripe fruit—in syphilis, insanity, epilepsy and as tonic.
Alternanthera sessilis R. Br.; Amarantaceæ; (Bo.-Kanchari); galact., cholag., in snake-bite.
Althæa officinalis Linn.; Malvaceæ; (H., Dec. & Bo.-Gul-khairo); in snake-bite.
A. rosea Linn. (vern. same as A OFFICINALIS); seeds—demulc., diur., febge.; roots—astrin., demulc.
Altingia excelsa Noronha.; Hamamelideæ; (H.-Siláras, M.-Neri arishippal); expect., stomch., antiscor.; benzaldehyde, cinnamic aldehyde; Arch. Pharm., 1901, 506.
Alysicarpus longifolius W. & A.; Leguminosæ; roots—subst. for liquorice.
A. vaginalis DC.
Alyxia stellata Röm. & Sch.; Apocynaceæ; alk.; Bull. Inst. Bot. Buitenzorg., 1904, Nr. 21. 33 (C. C. 1905, II. 975).
Amarantus anardana Hamilt.; Amarantaceæ; (H.-Chua, Bo.-Chuko); in scrofula and diar.
A. caudatus Linn.; (Himalayan name—Kedari-chua); leaves—oxalic acid; Compt. Rend., 1886, 1043.
A. farinaceus Roxb.; diur.
A. gangeticus Linn. (H.-Lalsag, B.-Dengua); poultice.
A. hypochondriachus Linn.; astrin.
A. mangostanus Linn. (H.-Chaulai).
A. paniculatus Miq. (B.-Chuko); in piles and diur. in strangury.
A. spinosus Willd. (S.-Tanduliya, H.-Kanta bhaji, B.-Kanta nutia, M.-Mulluk-kirai); in menor., gonor., eczema and sanke-bite
A. tristis Linn. (S.-Mekanada, Santh.-Pond-gandhari); demulc., diur., in snake-bite.
A. viridis Linn. (S.-Tanduliya); in snake-bite and scorpion-sting.
Ammania baccifera Linn.; Lythraceæ; (S.-Agnigarva, H.-Janglimendi, M.-Nirumel-neruppu); to raise blisters in rheum.
A. senegalensis Lam. (P.-Faugli mehndi); blistering agent.
Amomum aromaticum Roxb.; Scitamineæ; (H. & B.-Morang-ilachi, Bo.-veldode); seeds and oil as other species of amomum, essen. oil; Schim. Ber., 1897, April, 48.
A. melegueta Roscoe.; carmin. for cattle; essen. oil; Schim. Ber., 1915, April, 38; Jr. Amer. C. S., 1917, 1466.

Amomum subulatum Roxb. (S.-Brihat-upa-kunchika, H. & B.-Bara-elachi, M.-Periya-yelakkay); stomch., useful in neuralgia, scorpion-sting and snake-bite; essen. oil.[1]

A. xanthioides Wall. (H.-Ilayechi, B.-Elach); seeds—stim., carmin. Forty-five species of Amomum are uninvestigated.

Amoora rohituka W. & A. Meliaceæ; (S.-Rohitaka, H.-Harinhara, B.-Tiktaraj, M.-Raktarohida); aper., used in enlarged glands, liver and spleen diseases and corpulence.

Amorphophallus campanulatus Blume.; Aroideæ; (S.-Arsaghna, H.-Jungli suran, B.-Ol, M.-Karuna kalang); stomch., tonic, restor., carmin., in piles.

Amphicome emodi Lindl.; Bignoniaceæ; (Kash.-Kaur); subst. for chiretta; bitter alk.; Ann. Report, Ind. Museum, 1907-8, p. 21; Pharm. Jr. Vol. 79, 506.†

Amygdalus communis Linn.; Rosaceæ; (H. & B.-Badam, M.-Vadam-kottai); diur., root—alter.

A. persica Linn.; anthelm.; Stewart, Punj. Plants.

Amyris commiphora Roxb.; Burseraceæ; see BALSAMODENDRON ROX-*BURGHII* Arn.

Anabasis multiflora Moq.· Chenopodiaceæ; (P.-Ghalmc).

Anacardium occidentale Linn.; Anacardiaceæ; (H. & Bo.-Kájú, B.-Hijli bádám, M.-Mundiri-kai): bark—alter., astrin.; fruit—applied in leprosy, corn, ulcers, counter-irrit.; cardol, anacardic acid; Ber., 1887, 1861; Jr. Ind. Inst. Sci., 1923, 133; 1923, 111.†

Anacyclus pyrethrum DC.; Compositæ; (S.-Akara-karava, H., B. & Bo.-Akarkará, M.-Akkirakáram); cordial, stim., sialog., in rheum.; essen. oil., pellitorin or pyrethrin; Chem. News, 1895, 94, 100; Ber., 1927, 2284; 1928, 246; J. C. S., 1930, 6.†

Anagallis arvensis Linn.; Primulaceæ; (H.-Jonkhmári); in gout, dropsy, as fish poison, snake-bite; saponin, enzyme; Jr. Pharm. Chim., 1846, 339; Ann. Chim. Farmac., 1892, 20.

Anamirta cocculus W. & A.; Menispermaceæ; (S.-Kákaphala, H. & B.-Kákmári, M.-Kákkáy-kolli-virai); seeds—in nightsweats of phthisis; picrotoxin, cocculin, anamirtin; Ber., 1881, 817; 1898, 2958; Pharmac. Chemie, 4th edition, Vol. II, 1901, 1646.†

Ananas sativa Linn.; Bromeliaceæ; (H.-Anannas, B.-Anáras, M.-Anásha pazham); leaves—anthelm., fruit—abortif.; bromelin, As—0,008 mg. in 100 g.; Compt. Rend. 1914, 893 (C.C. 1914. I. 1730); Pharm. Centralh., 1892, 32; alk., Apoth. Ztg., 1895, 895; Jr. Amer. C. S., 1925, 1177.†

Anaphalis neelgerriana DC.; Compositæ; (Nilgiris.-Kaat-plaster); leaves —applied to wounds.

Anastatica hierochuntia Linn.; Cruciferæ; (H. & Bo.-Garvaphul); in difficult labour.

Andira araroba.; Leguminosæ; (goa powder) in ringworm; chrysophanic acid; J. C. S., 1902, 1575; Arch. Pharm., 1925, 321, 436.†

Andrachne cordifolia Müll.; Euphorbiaceæ; (P.-Gurguli); poisonous to cattle.†

Andrographis echioides Nees.; Acanthaceæ; (M.-Peetumba, Dec.- Ranchi-mani); in fever.

A. paniculata Nees. (S.-Bhunimba, H.-Kiryát, B.-Kálmegh, M.-Nila vembu); for griping and fever; kalmeghin; Amer. Jr. Pharm., 1914, 349.*†

Andropogon citratus DC.; Gramineæ; (S.-Bhústrina, H.-Aginghás, B.-Gandhabená, M.-Vásanapulla); diaphor., stim., oil—carmin., in cholera; essen. oil; Pharm. Jr., 1923, 660; Schim. Ber., 1915, Oct., 35; 1922, 43; Perf. Rec., 1926, 83.

Andropogon iwarancusa Roxb. (S.-Lámajjaka, H.-Lamjak, B.-Káránkusa); carmin., stim., emmen.; essen. oil; Schim. Ber., 1892, April, 44; J. C. S., 1921, 1644; 1922, 2292; 1923, 2267; Bull. Imp. Inst. Lond., 1924, 265; Ind. For. Rec., 1922, 111.†

A. muricatus Retz. (S.-Usira, H.-Khas, B.-Khaskhas, M.-Vetti-ver); refrig., stomch., diaphor., diur., emmen.; essen. oil; Chem. & Drug., 1914, 225; Jr. Ind. Inst. Sci., 1925, 147; Schim. Ber., 1902, 84; 1903, 76.

A. nardus Linn. (S.-Guchcha, H.-Ganjni, B.-Kamá-kher, M.-Kámákshipullu); use same as A. MURICATUS; essen. oil; Bull. Imp. Inst., 1910, 144; Schim. Ber., 1913, 19.

A. odoratus Lisboa. (Bo.-Ushadhana); carmin.; essen. oil; Schim. Ber., 1892, April, 44; 1912, April, 23; 1913, Oct., 19; Pharm. Weekbl., 1924, 1182.

A. schœnanthus Linn. (S.-Bhutrina, H. & B.-Gandhabena, M.-Shakanárúpillú); arom., stim.; essen. oil; Schim. Ber., 1911, April, 19; Oct., 17; J. C. S., 1922, 144.

Aneilema scapiflorum Wight.; Commelinaceæ; (H.-Siyah músli, B.-Kureli, Bo.-Sismulia); roots—astrin., tonic, in snake-bite.

A. tuberosum Ham.; astrin., tonic; Stewart, Punj. Plants.

Anemone obtusiloba Don.; Ranunculaceæ; (P.-Rattanjog); externally as a blister.†

Angelica glauca Edgw.; Umbelliferæ; (P.-Chora); cordial, stim., in dyspep. and constip.

Anisochilus carnosus Wall.; Labiatæ; (H.-Pánjiri-ká-pát, M.-Karpuravalli); stim., expect.; essen. oil.

Anisomeles malabarica R. Br.; Labiatæ; (S.-Butan-kusham, Bo.-Chodhará, M.-Karin-toomba); in colic and dyspep., in scorpion-sting and snake-bite; essen. oil.

A. ovata R. Br. (Bo.-Gobura); carmin., astrin., tonic, in uterine affections.

Anœctochilus setaceus Blume.; Orchideæ; (Sing.-Wanna-rajah).

Anogeissus latifolia Wall.; Combretaceæ; (H.-Bakla, M.-Vakkali); astrin., in scorpion-sting and snake-bite.

Anona reticulata Linn.; Anonaceæ; (H.-Loná, B.-Noná, Bo.-Rámphal, M.-Ramsitá); bark—astrin., fruit—anthelm.

A. squamosa Linn. (S.-Gandhagatra, H.-Sitáphal, B.-Atá, M.-Sitapalam); root—purg., seeds—insecticide; amorph. alk., toxic. resin; Jr. Ind. Inst. Sci., 1924, 232.†

Anthemis nobilis Linn.; Compositæ; (H.-Bábuni-ke-phul, M.-Shimaichamantipu); properties same as MATRICARIA CHAMOMILLA, flowers—stim., tonic, carmin.; essen. oil anthemene, anthemic acid; Schim. Ber., 1903, 37; 1915, April, 41; 1922, 55; J. C. S., 1914, 1829.†

Anthocephalus cadamba Miq.; Rubiaceæ; (S. & H.-Kadamba, B.-Kadam, M.-Vella-kadamba); bark—tonic, febge., astrin. in snake-bite; principle similar to cinchotannic acid.

Anthriscus cerefolium Hoffm.; Umbelliferæ; (Ind. Baz.-Atrilal); diur., stomch., deobst.; essen. oil, glucd. apiin; Bull. Soc. Chim., 1899, 368; Ann. Chim. Phys., 1843, 250.

Antiaris innoxia Bl.; Urticaceæ; Pharm. Jr. Trans., 1892, 1127 and 613.

A. saccidora Dalz.

A. toxicaria Lesch. (Bo.-Chándla, M.-Nettávil, Sing.-Riti, Burm.-Hmyaseik); fish and arrow poison, seeds—febge., in dysen.; glucds. α-antiarin, β-antiarin, γ-antiarin, antiaresin, toxicarin; Arch. Pharm., 1896, 438; 1908, 504; Ber., 1910, 3574; 1913, 2179.*†

Anticharis arabica; Scrophularineæ; in diabetes; Murray, Drugs of Sind.
Antidesma alexiteria Linn.; Euphorbiaceæ; (M.-Noli-tali-maram); leaves —in snake-bite.
A. bunius Muell-Arg. (M.-Noli-tali, Nep.-Himal cheri); antid. to sanke-poison.
Antirrhinum glaucum stocks.; scrophularineæ; in diabetes, earache; Murray, Drugs of Sind.
Apium graveolens Linn.; Umbelliferæ; (S. & H.-Ajmoda, B.-Chanu); tonic, carmin., diur., emmen.; essen. oil, glucd. apiin.; Schim. Ber., 1909, Oct., 105; 1910, April, 95; Ann. Chim. Phys., 1843, 250.
A. petroselinum. see PETROSELINUM SATIVUM Linn.
Aplotaxis auriculata DC.; Compositæ; stim., in phthisis, dropsy, jaundice; N. Sen, Ayur. Med.; Prain, Beng. Plants.
Aporosa lindleyana Bail.; Euphorbiaceæ; (S.-Valaka, M.-Vettil); decoct. of the root—in jaundice, fever, headache, seminal loss and insanity.
Aquilaria agallocha Roxb.; Thymelæaceæ; (S. & B.-Agaru, H., Bo. & M.-Agar); stim., carmin., tonic, in snake-bite; essen. oil; Schim. Ber., 1928, 3.
Aquilegia vulgaris Linn.; Ranunculaceæ; HCN-glucd.; Pharm. Post. 1891, 659; Bull. Soc. Chim. (3) 1898, 310.
Arachis hypogæa Linn.; Leguminosæ; (S.-Buchanaka, H.-Mungphali, B.-Chiner bádám, Bo.-Bhui-chane, M.-Nila kadalai); oil—aper., emol.*
Arachne cordifolia Müll.; cattle poison; Prain, Beng. Plants.†
Aralia pseudo-ginseng Benth.; Araliaceæ; aphrodis., stim. in dyspep., vomiting.
Arctostaphylos uva ursi Spreng.; Ericaceæ; astrin., diur.; N. Sen, Ayur. Med.; Prain, Beng. Plants.
Ardisia colorata Roxb.; Myrsineæ; febge.
A. humilis Vahl.; stim., carmin.; N. Sen, Ayur. Med.; Prain, Beng. Plants.
Areca catechu Linn.; Palmæ; (S.-Gubak, H. & B.-Supári, Bo.-Sopari, M.-Kamugu); in snake-bite, anthelm.; alks. arecaine, arecaidine, arecoline, guvacine; Ber. Pharm. Ges., 1920, 392; Jr. Pract. Chem., 1927, 147.*
A. concinna DC.; Palmæ; alk.; Arch. Pharm., 1901, 368; 1905, 247.
Argemone mexicana Linn.; Papaveraceæ; (S.-Srigala-kantaka, H. & B.-Siálkántá, M.-Birama-dandu); oil—purg., antid. to snake-poison; alks. berberine, protopine; Jr. Amer. C. S., 1902, 238; Pharm. Rev., 1901, 458; Arch. Pharm., 1901, 401.*
Argyreia fulgens Chois.; Convolvulaceæ; leaves—antiphl.
A. malabarica Chois.; (M.-Paymoostey); roots—cath., leaves—used to promote maturation of boils.
A. speciosa Sweet.; (S.-Vriddhadáraka, H.-Samandarka-pat, B.-Bichtaraka, M.-Shamuddira-pachchai) leaves—antiphl.
Arisæma curvatum Kunth.; Araceæ; used as poison.; O'Shaughnessy, Beng. Disp.
A. leschenaultii Blume. (Sing.-Wal-kidaran).
A. speciosum Mart. (P.-Kiralu); antid. to snake-poison.
A. tortuosum, Schott. (P.-Samp-ki-Kumb); root—anthelm for cattle.
Aristolochia bracteata Retz.; Aristolochiaceæ; (S.-Dhumrapatra, H.-Kirámar, M.-Adutina-palai); purg., anthelm., emmen., antide to snake-poison; volatile substance and alk.; Pharm. Jr., 1891-92, 551; Pharm. Ind., Vol. III, p. 163; Arch. Exp. Path., 1891, 232; Henry, Plant Alkaloids, 1924, p. 376†
A. indica Linn. (S.-Rudrajata, H. & B.-Isharmul, M.-Ichchura-mula); emmen., in snake-bite; alk.; same as A. BRACTEATA.
A. longa Linn. (Ind. Baz.-Zarwand-i-tawil); in cobra-bite.

Aristolochia reticulata Nuttal.; N. Sen, Ayur. Med.; Prain, Beng. Plants.
A. rotunda Linn. (Ind. Baz.-Zarawand-i-gird); properties similar to A INDICA; alk. aristolochine; Arch. Exper. Path. Pharm., 1891, 282 and 642
A. roxburghiana Klotz.; used in bowel complaints.
A. serpentaria Linn.; essen. oil, bitter substance; Gaz. Chim. Ital., 1887, 313; Jr. Pharm. Chim., 1911, 399.
Arnica montana Linn.; Compositæ; stim., sedative, resolv.; N. Sen, Ayur. Med.; Prain, Beng. Plants.
Artabotrys suaveolens Blume.; Anonaceæ; in cholera; alk. artabotrine; Phil. Jr. Sci. 1929, 259.
Artanema sesamoides Benth.; Scrophularineæ; (S.-Kokilaksha, M.-Neermulli); decoct. of root—given in rheum., diar., stone, syphilis, opthalmia, seeds—cure biliousness, improve vitality and favour conception.†
Artemisia absinthium Linn.; Compositæ; (H & Dec.-Viláyati afsantin); tonic in intermittent fevers; glucd. absinthin, essen. oil; Arch. Pharm., 1892, 94; Schim. Ber., 1930, 92; Bull. Soc. Chim., 1898, 537.
A. annua Linn.; essen. oil.; Schim. Ber. 1905, April, 86; 1907, April, 14; *Chem. & Drug. 1917, 376 and 746.*
A. biennis Willd.; essen. oil.; Gildemeister-Hoffmann, 2, Aufl. III. 698.
A. indica Willd.; O'Shaughnessy, Beng. Disp.†
A. maritima Linn. (S.-Gadadhar, H.-Kirmala, Bo.-Kiramáni owa); flower heads—anthelm; santonin, bitter substance, artemisin; J. C. S., 1896, 59; I. M. G., 1924, p. 537; In Kurram valley it was found to contain 1.75% santonine; Quarterly Jr. of Pharmacy & Pharmacology, 1932.
A. persica Boiss. (Bo.-Pardesi dawano); tonic, febge., vermifuge.
A. sacrorum Ledeb. (P.-Tatwen); given to horses in head affections.
A. scoparia Waldst. & Kito.; (P.-Jhau); purg.
A. siversiana Willd. (Bo.-Afsantin); tonic, febge., anthelm., emmen.
A. vulgaris Linn. (S.-Nágadamani, H.-Nágadouná, B.-Nágdoná); anthelm., antisep., expect.; essen. oil; Schim. Ber., 1904, April, 97; 1913, April, 25; Bull. Imp. Inst. Lond., 1913, 436; Jr. Pharm. Soc. Japan, 1924, 510.

The following specis of Artemisia are uninvestigated:—
A. amygdalina *Dcne.*, A. campbellii *Hk. f. & T.*, A. caruifolia *Ham.*, A. desertorum *Spreng.*, A. dracunculus *Linn.*, A. macrocephala *Jacq.*, A. minor *Jacq.*, A. mollissima *D. Don.*, A. moorcroftiana *Wall.*, A. parviflora *Roxb.*, A. roxburghiana *Bcss.*, A. royleana *DC.*, A. salsoloides *Willd.*, A. stracheyi *Hk. f. & T.*, A. stricta *Edgew.*, A. tournefortiana *Rchb.*, A. vestita *Wall.* (Hk. Fl. Br. Ind.).

Arthrocnemum indicum Moq.; Chenopodiaceæ; (S.-Subhar, B.-Jadu pálang, Bo.-Machola, M.-Umari); in scorpion-sting.
Arthrophyllum blumeanum Zoll. & Mor.; Araliaceæ; alk.; Bull. Inst. Bot. Buitenzorg, 1902, XIV. 24; Meded. Lands Plantent. 1902, 73.
Artocarpus hirsuta Lamk.; Urticaceæ; (Bo.-Rán phanas, M.-Anjalli); leaves—in bubos and swelled testicles.
A. integrifolia Linn. (S.-Panasa, H. & B.-Kanthal, Bo.-Phanas, M.-Pilápazham); leaves—in skin diseases; root—in diar., juice—in glandular swelling, in snake-bite; morin, cyanomaclurin; J. C. S., 1895, 337; Proc. Chem. Soc., 1902, 139; 1904, 170.†
A. lakoocha Roxb. (S.-Lakucha, H. & Bo-Dahua); seeds—purg.
Arum curvatum Roxb.; Aroideæ; Stewart, Punj. Plants.
Asagræa officinale Lindl.; Liliaceæ.
Asarum europœum Linn.; Aristolochiaceæ; (S.-Upana, H. & Bo.-Taggar); roots and leaves—emetic, cath. essen. oil, glucd.; Jr. Pharm. Chim.. 1911, 399; Ber., 1888, 1057.

Asclepias curassavica Linn.; Asclepiadeæ; (H.-Kakatundi, Bo.-Karki); emetic, styptic; glucd. asclepiadin, vincetoxin; Arch. Exper. Path., 1885, 389; Compt. Rend., 1885, 277; Jr. Pharm. Chim., 1884, 210.†
Asparagus adscendens Roxb.; Liliaceæ; (H.-Safed musli, Bo.-Sápheta musali); demulc., galact., tonic; asparagin.
A. filicinus Ham. (P.-Allipalli); root—tonic and astrin.
A. gonoclados Baker. (B.-Satamuli, Bo.-Shatávari, M.-Kilávari); root—aphrodis, used in gonor.
A. officinalis Linn. (H.-Halyun, B.-Hikua); demulc., diur., tonic, aphrodis; essen. oil, asparagin, tyrosin; Arch. Exp. Path. Pharm., 1894, 205; Gesch-Ber., 1909, April-Sept.
A. punjabensis; (P.-Sensarpál).
A. racemosus Willd. (S. & B.-Shatamuli, H.-Shatáwar, Bo.-Satávari, M.-skirai shadavari); root—refrig., demulc., diur., antidysen.
Asphodelus fistulosus Linn.; Liliaceæ; (P.-Piázi); diur.
A. tenuifolius Cavan. (P.-Piázi); seeds—diur.
Asplenium adiantum-nigrum Linn. (Eng.—Black spleen wort).
A. ceterach Linn.
A. falcatum Willd. (Bo.-Pána; M.-Nela pánna maravara); in enlargement of spleen, incontinence of urine, calculus, jaundice, malaria.
A. parasiticum Willd. (Bo.-Mohá pána, M.-Kári-beli-pánna-maravara); use same as A. FALCATUM.
A. ruta-muraria Linn. (Eng.-Wall Rue); expect., subst. for Maiden-hair.
A. trichomanes Linn. (M.-Myle conday); anthelm.
Aster trinervius Roxb.; Compositæ; in hæmor., malaria; Chinese Mat. Med.
Asteracantha auriculata Ness, see HYGROPHILA SPINOSA T. Anders.
Asteriastigma macrocarpa Bedd.; Bixineæ; (M.-Vellanangu); oil from seeds is believed to be a valuable medicine; Compt. Rend., 1925, 181, 1089.
Astragalus hamosus Linn.; Leguminosæ; (H.-Purtuk); emol., demulc.; a gum-like tragacanth; Pharm. Centralh., 1924, 637; Apoth. Ztg., 1924, 632.
Astragalus heratensis Bunge. (Pers.-Gabina).
A. multiceps Wall. (P.-Kanderi); seeds—for colic and leprosy.
A. sarcocola Dymock. (H.-Anjira, Bo.-Gujar), gum—aper.; Apoth Ztg., 1920, 113; 1924, 632; Pharm. Centralh, 1924, 637.
A. strobiliferus Royle. (Pers.-Kon); gum-like tragacanth; Pharm. Centralh., 1924, 637; Apoth. Ztg., 1924, 632.
A. tribuloides Delile. (P.-Ogái); seeds—demulc.; Pharm. Centralh., 1924, 637; Apoth. Ztg., 1920, 113; 1924, 632.
A. virus Oliver.; gum—emol., demulc.
Asystasia coromandeliana Nees.; Acanthaceæ (S.-Lavana-valli, M.-Medday keerai); juice of the plant given in swellings, worms and rheum.
Atalantia monophylla Corr.; Rutaceæ; (S.-Atavi-jambira, Bo.-Mákadlimbu, M.-Káttu-elumichcham-param); root—antisp., stim., in snake-bite.
Atriplex hortensis Linn.; Chenopodiaceæ; seeds—saponin; Pharm. centralh., 1926, 435.
A. laciniata Linn.; saponin; Kew. Bull., 1909, 397.
Atropa acuminata Royle.; Solanaceæ; O'shaughnessy, Beng. Disp.
A. belladonna Linn. (H.-Sag-angur, B.-Yebruj, Bo.-Girbuti); sedative, antisp., anodyne, atropine, hyoscyamine; Pharm. Jr., 1889, 461; J. C. S., 1899, 72; 1901, 71; 1908, 2077; 1912, 957; I. J. M. R., 1926, 535.[B]
Atylosia barbata Baker.; Leguminosæ; (S.-Mashaparni, M.-Peruvidukol); roots—in rheum., biliousness, fever, consumption and swelling.
Avena fatua Linn.; Gramineæ; (H.-Kuljud); used as poison.

Avena sativa Linn.; As—50 mg. in 100 g. fresh plant and 62 mg. in dry; Compt. Rend., 1914, 268 (C. C. 1914, II. 885).
Averrhoa bilimbi Linn.; Geraniaceæ; (H.-Belambu, B.-Blimbi, Bo.-Blimbu, M.-Bilimbikáy); astrin., stomch., refrig.
A. carambola Linn. (H.-Karmal, B.-Kamrángá, Bo.-Karamara, M.-Tamarta); fruits—antiscor., used in fevers; acid potassium oxalate.
Avicennia officinalis Linn.; Verbenaceæ; (B.-Bina, Bo.-Tivar, M.-Nallamada); bark—astrin., in small pox.
A. tomentosa Roxb. (H. & B.-Bina, Bo.-Cheriá); root—aphrodis, bark—astrin; lapachol; Arch. Pharm., 1913, 351.
Azima tetracantha Lam.; Salvadoraceæ; (S.-Kundali, H.-Kántagurkamai, B.-Trikanta-gati, Bo.-Sukkapát, M.-Sungam-chedi); diur., in rheum., dropsy, dyspep., chr. diar.

Balanites roxburghii Planch.; Simarubeæ; (S.-Ingudi, H. & B.-Hingan, Bo.-Hinger, M.-Najundá); purg., anthelm., expect., in snake-bite; saponin; Arch. Pharm., 1901, 363.
Baliospermum axillare Blume.; Euphorbiaceæ; (S., H. & B.-Dánti, Bo.-*Dántimul, M.-Naga-danti); root and seed—purg. and in snake-bite*; leaves—in asthma.
Ballota limbata Benth.; Labiatæ; (P.-Bui); leaves—applied for inflam. of gums and ophthalmia.
Balsamodendron mukul Hook.; Burseraceæ; (S.-Guggulu, H., B. & Bo.-Guggul, M.-Gukkulu); demulc., aper., alter., carmin., antisp., emmen.; Schim. Ber., 1925, 110.'
B. myrrha Nees. (S.-Rasagandha, H.-Bol, B.-Gandharash, M.-Vellaip polam); in dyspep., chlorosis, amenor.; essen. oil, bitter substance; Analyst, 1909, 519; Arch. Pharm. 1906, 412.
B. opobalsamum Kunth. (H.-Balásán, Bo.-Habbul balasán); fruit—carmin., expect., stim.; balsam—astrin., demulc., given in discharges from genito-urinary organs; essen. oil, bitter substance; Arch. Pharm., 1895, 241.
B. playfairii Hook. (Bo.-Meena-harma); expect., in rheum.; saponin; Pharm. Jr., 1913, 369.
B. pubescens Stocks. (Bo.-Bayisa-gugul); in Delhi boil.
B. roxburghii Arn. (S.-Kumuda, B.-Gugala, Bo.-Gugal, M.-Gukul); gum—demulc., aper., carmin., alter., in snake-bite and scorpion-sting.
Bambusa arundinacea Retz.; Gramineæ; (S.-Vansa, B. & H.-Báns, Bo.-Mandgay, M.-Mangal); leaves—used in hæmetemesis and vet. practice, bamboo manna—tonic, useful in fever, cough, in snake-bite, etc.; cholin, betain; Z. Physiol. Chem. 1909, 113; 1911, 388; nuclease, urease, proteolytic enzyme, diastatic and emulsifying enzyme; Z. Physiol. Chem., 1911, 456; 'bangsolochan', 'tabashir'; Centralblat. Agri. Chem., 1887, 789; cyanogenetic glucd.; Bull. Acad. St. Petersbg., 1911, 397.†
Barleria ciliata Roxb.; Acanthaceæ; N. Sen, Ayur. Med.; Prain, Beng. Plants.
B. courtallica Ness. (S.-Chethasabacharam, M.-Venkurunji); decoct. of root—in rheum., pneumonia, oil—boiled with leaves in ear and eye disease.
B. cristata Linn. (S. & B.-Jhinti, P.-Tadrelu); in snake-bite, decoct.—subst. for human milk.
B. dichotoma Roxb.; stim., demulc.
B. longiflora Linn.; decoct. of the root is given in stricture, dropsy and stone.
B. noctiflora Linn.; decoct.—subst. for human milk.

Barleria prionitis Linn. (S. & Bo.-Vajra danti, B.-Kántájáti, H.-Katsareyá, M.-Shemmuli); in catar., cough, anasarca; alk.

B. strigosa Willd. (B.-Dasi, Santh.-Raila-baha, Bo.-Wáhiti); root—used in severe spasmodic cough.

Barringtonia acutangula Gærtn.; Myrtaceæ; (S.-*Dhátriphal*, B.-*Hijál*, H.-Hijjal, Bo.-Samudraphala, M.-Samutra-pullam); emtic, expect., fish poison; glucd.-saponin barringtonin; Pharm. Weekbl., 1903, 729.

B. racemosa Blume. (S.-Samudrapad, H.-Norvishee, B.-Samudraphal, M.-Samudra); cooling; fruit—in cough, asthma, diar.; root—similar to cinchona; glucd.-saponin.

B. speciosa Forst (Burm.-Kyi, Andaman.-Doddá); narcotic, stupefies fish; glucd.-saponin barringtonin; Pharm. Weekbl., 1903, 729

Basella alba Linn.; Chenopodiaceæ; (S.-Potaki, H. & B.-Poi, M.-Vasla-kire); leaves—demulc., cooling, used in urticaria.

B. rubra Linn. (S.-Putika, H.-Lálbachlu, B.-Rakto-pui, M.-Shivappu-vasla-kire); leaves—in catar. affections and to hasten suppuration.

Bassia butyracea Roxb.; Sapotaceæ; (H.-Phalwára, Nep.-Churi); fat—in rheum., emol.

B. latifolia Roxb. (S.-Madhuka, H. & B.-Mahua, M.-Káttu-irrupai); flowers—astrin., tonic, appetising, bark—astrin., tonic, alk. in leaves; Bull. Inst. Bot. Buitenzorg. 1902. XIV. 30.*

B. longifolia Linn. (S.-Madhuka, H.-Mohuá, B.-Mohuvá, Bo.-Mahwa, M.-Illupai); bark—astrin., emol., flowers—stim., anthelm., used in snake-bite; a poisonous saponin, mowrin, bitter substance; Ber. Pharm. Ges., 1918, 100; Biochem. Jr., 1909, 94; Pharm. Jr., 1909, 364; Z. Physiol. Chem., 1919, 31.*

B. malabarica Bedd.; (M.-Iluppi); fruits—in rheum., biliousness, consumption, asthma and worm; seeds yield an oil used in rheum. and for improvement of the hair; flowers—soaked in water used in kidney complaints.†

Bauhinia macrostachya Wall.; Leguminosæ; (B.-Gunda-gilla); in skin lesions.

B. purpurea Linn. (S.-Kánchan, H.-Koliár, B.-Rakta-kanchan, P.-Koiral, M.-Mandareh); bark—astrin., root—carmin., flowers—laxt.

B. racemosa Lam. (S.-Svetakánchan, H.-Kanchnal, B-Banraj, P.-Kosundra, M.-Areka); gum—used medicinally, leaves—in headache and malaria.

B. retusa Ham. (H.-Kandla, P.-Kurál); gum—used for sores, emmen., diur., Pharm. Jr., 1892, 1073.

B. tomentosa Linn. (S.-Aswamantaka, H.-Káchnar, Bo.-Asundro, M.-Kanchini); antidysen.; anthelm., fruits—diur., seeds—tonic and aphrodis; used in snake-bite and scorpion-sting.

B. vahlii W. & A. (H.-Jallaur, B.-Chehur, M.-Adda); seeds—tonic, aphrodis.; leaves—demulc., mucil.; Pharm. Jr. 1892, 1073.

B. variegata Linn. (S.-Kovidára, H.-Kachnár, B.-Raktakánchan, M.-Segapu-munthari); alter., tonic, astrin., in scrofula, ulcers, dysen., antid. to snake-poison; gum; Pharm. Jr., 1892, 1073.

Begonia rex Putzeys.; Begoniaceæ; subst. for rhubarb, juice—poisonous to leeches.

Belamcanda chinensis Leman.; Irideæ; roots—aper., resol., antid. to snake poison.

Berberis angulosa Wall.; Berberideæ.

B. aristata DC. (S.-Daru haridrá, H.-Dar-hald); root—purg., in remittent fevers.*

B. asiatica Roxb. (H.-Kilmora, Nepal.-Chitra); in snake-bite.*

B. coriacea Brandi. (Simla.-Kashmal).*

Berberis lycium Royle. (H.-Kashmal., Bo.-Darhald) ; extract—febge., in eye disease.*

B. nepalensis Spreng. (P.-Amudanda, Nep.-Chatri).*

B. vulgaris Linn. (P.-Kashmal) ; astrin., diur.; alks.—berberine, oxyeanthine, berbamine; Arch. Pharm., 1891, 631; 1895, 161; 1926, 193; Ber., 1886, 3190; Jr. Amer. Pharm. Assoc., 1926, 33.*
Var. aetnensis *Presl.*; berberine; J. C. S. 1897, 1194.
Var. cratalgina.

Beta bengalensis, Roxb.; Chenopodiaceæ; (S.-Palanki, H.-Pálak, B.-Bit-pálang) ; seeds—cooling, diaphor.

B. maritima Linn. (S.-Palanki, H.-Palák, B.-Bit-pálang) ; seeds—cooling, diaphor., leaves—in burns and bruises.

Betula acuminata Wall.; Cupuliferæ.

B. alba Linn.; oil—in chr. eczema, leaves—in rheum., dropsy.

B. alnoides Ham.; in snake-bite.

B. bhojpattra Wall. (S. & B.-Bhurjapatra, H.-Bhujpattra, Bo.-Bhojapatra) ; bark—antisep.; betulin, essen. oil; Ber., 1876, 1442; 1879, 7; Apoth. Ztg., 1904, 854; Ber., 1905, 1636; Schim. Ber., 1913, April, 25; 1918, 8.†

B. utilis Don. vern. same as B. BHOJPATTRA.

Bidens trifida Buch.; Compositæ; used in chr. dysen., eczema.; Chinese, Mat. Med.

Bignonia grandiflora Willd.; Bignoniaceæ; Chinese Mat. Med.

Biophytum sensitivum DC.; Geraniaceæ; (H.-Lajalu, Bo.-Lajri); in gonor. and lithiasis.

Bixa orellana Linn.; Bixineæ; (H. & B.-Latkan, Bo.-Shendri, M.-Japhra-maram); fruit—astrin., purg; seeds and root—cordial, astrin., febge.; leaves—in jaundice and snake-bite; colouring matter, bixin; Arch. Pharm., 1900, 58; Jr. Ind. Inst. Sci., 1924, 225; Jr. Amer. Pharm. Assoc., 1922, 999.

°**Blepharis edulis** Pers.; Acanthaceæ; (H.-Utanjan, Bo.-Utangan); resolv., diur., aphrodis., expect.; crystalline bitter principle; Pharm. Ind., Vol III, 41.

Blumea balsamifera DC.; Compositæ; (H.-Kakoranda, Bo.-Bhamaruda); sudorific, carmin., expect.; camphor; Phil. Jr. Sci., 1909, A 127; Schim. Ber., 1910, April, 149; 1926, 8.

B. densiflora DC. (Burm.-Pung-ma-theing) ; essen. oil, camphor; Schim. Ber., 1920, 70; Chem. & Drug., 1920, 425.

B. eriantha DC. (Bo.-Nimurdi) ; carmin., sudorific.

B. lacera DC. (S.-Kukurandru, H.-Kakoranda); essen. oil., camphor; Perf. Rec., 1909, 252.*
Thirty species of Blumea are uninvestigated.

Bocagea dalzellii Hk. f. & Thoms.; Anonaceæ; (Bo.-Andi) ; leaves—bitter and pungent, used in fermentation; glucd.; Pacif. Record, 1892, 304.

Bœrhaavia diffusa Linn.; Nyctagineæ; (S.-Shothaghni, H.-Sánt, B.-Punarnaba, Bo.-Ghetuli, M.-Mukuk-rattai); laxt., diaphor., used in œdema, anæmia and heart diseases, diur., antid. to snake-venom; alk. punarnavine; I. M. G., 1923, No. 5.*

Boletus crocatus Batsch. (Ind. Baz.-Phausamba) ; used in excessive salivation, in diar., dysen.

B. nitus artocarpalis.

Bombax malabaricum DC.; Malvaceæ; in snake-bite.; Jr. Soc. Chem. Ind., 1911, 469; Bull. Imp. Inst. Lond., 1920, 335.

Bonnaya brachiata Link & Otto.; Scrophularineæ; N. Sen, Ayur. Med.; Prain, Beng. Plants.

Borassus flabelliformis Murr.; Palmæ; (H.-Taltar, B.-Tal); root—cooling, restor., juice—diur., stim., pulp—demulc., nutri.; Jr. Pharm. Chim., 1904, 193.

Boswellia bhan-dajiana Birdwood.; Burseraceæ.

B. glabra *Roxb.* (*S. & B.-Guggul, H.-Gugal*); arom., demulc., aper., alter., emmen., used in rheum., skin diseases.

B. serrata Roxb. (S.-Shallaki, H. & B.-Luban); diaphor., diur., emmen.; essen. oil; Bull. Imp. Inst. Lond., 1919, 159; Jr. Soc. Chem. Ind., 1923, 486; Jr. Ind. Inst. Sci., 1925, 221; Ind. For. Rec., 1918, 303.

B. thurifera Cole; Chinese Mat. Med.

Botrychium lunaria Sw.; in dysen.

Boucerosia aucheriana Dcne.; Asclepiadeæ; bitter tonic, febge.

Bragantia tomentosa Blume.; Aristolochiaceæ; emmen.

B. wallichii R. Br.; root and leaves—sedative, used in snake-bite.

Brassica campestris *Linn.*; *Cruciferæ; in snake-bite.*; Jr. Amer. C. S., 1903, 690; Jr. Soc. Chem. Ind., 1898, 992.

B. nigra Koch.; seeds—stim., rubft., vesicant, used in snake-bite; glucd. sinigrin; Arch. Pharm., 1863, 132 and 214; 1897, 44; Schim. Ber., 1923, 72; 1925, 72.

Brayera anthelmintica Kunth.; Rosaceæ; (H.-Cusso); dried flowers and tops—anthelm.; α-and β-kosin and kosotoxin; Arch. Pharm., 1899, 481; 1901, 672; Bull. Chim. Pharm., 1897, 609; Jr. de Pharm. 1888, 507.

Breynia rhamnoides Muell.-Arg.; Euphorbiaceæ.

Bridelia montana Willd.; Euphorbiaceæ; (H.-Kargnalia, Assam.-Kaisho); anthelm., *astrin.*

B. retusa Spreng. (H.-Khaja, M.-Mullu-vengai); astrin.

Brunella vulgaris Linn.; Labiatæ; (P.-Austakhadus, Bo.-Ustukhudus); expect., antisp.; bitter principle and essen. oil; Pharm. Post. 1913, 625; Jr. Russ. Phys.-Chem. Ges., 1903, 831.†

Bryonia callosa Rottl.; cucurbitaceæ; anthelm.; O'shaughnessy, Beng. Disp.

B. epigæa Rottl.; aper., alter., used in chr. dysen.; O'shaughnessy, Beng. Disp.

B. laciniosa Linn. (S.-Baja, H.-Bajguriya); used in bilious attack, in *fevers with flatulance; bitter principle, bryonin; Pharm. Ind., Vol.* II, 93; Biochem. d. Pflzen., 2 Aufl., 1921, III. 293.†

B. pilosa Roxb.; used in snake-bite; O'shaughnessy, Beng. Disp.

B. rostrata Rottl.; astrin.; O'shaughnessy, Beng. Disp.

B. scabrella, Linn.; O'shaughnessy, Beng. Disp.

B. umbellata Willd.; Stewart, Punj. Plants.

Bryophyllum calycinum Salisb.; Crassulaceæ; (B.-Koppata); leaves—applied to wounds, boils and bites of insects.

Buchanania latifolia Roxb.; Anacardiaceæ; (S., H. & B.-Piyal, M.-Mowda); demulc., alter.

Butea frondosa Roxb.; Leguminosæ; (S.-Kinsuk, H. & B.-Palas); anthelm., in snake-bite; gum-kino; leaves—glucd.; Proc. Chem. Soc., 1903, 134; 1904, 169; J. C. S., 1904, 1459.†

B. superba Roxb. (S.-Lata palas, H. & B.-Palas lata, M.-Kodi-murukkan); for poisonous bites; gum-kino.

Buxus sempervirens Linn.; Euphorbiaceæ; (Kash.-Chikri, P.-Papri); wood—diaphor., leaves—bitter, purg., diaphor., in rheum., syphilis, bark—febge.; alks. buxine, para-buxine, buxinidine, buxinamine; Pharm. Jr., 1882, 23; Ber., 1884, 2655; Arch. Pharm., 1898, 530.†

Caccinia glauca Savi.; Boragineæ; (Ind. Baz.-Gaozaban); alter., tonic, diur., demulc., in syphilis, rheum.

Cadaba farinosa Forsk.; Capparideæ; (Arab.-Asal, Sarah); leaves—purg., anthelm., antisyp., emmen., aper.; alk.; Pharm. Ind., Vol. I, 138; Dragendorff, Heilpflanzen, 262.

C. indica Lamk. (M.-Velivi); alk.; Dragendorff, Heilpflanzen, 260.

C. trifoliata W. & A. (M.-Viluthee).

Cæsalpinia bonduc Roxb.; Leguminosæ; (S.-Latá karanja, H.-Kat-karanj, B.-Nata-karanja, Bo.-Sagaragota, M.-Gajega); in rheum.

C. bonducella Fleming. (S.-Kuberakshi, H.-Kat-karanj, B.-Nata-karanja, Bo.-Sagaragoth, M.-Gajega); antiper., tonic, in snake-bite; a bitter substance, bonducin; Jr. Pharm. Chim. 1886, 115; Ber. Pharm. Ges., 1902, 143; I. J. M. R., 1929, 377.* †

C. coriaria Willd. (Bo.-Libi-dibi, M.-Shumak); in intermittent fever; pod—astrin., antiper., tonic.

C. digyna Rottl. (H.-Vakeri-mul, B.-Umul-kuchi, Bo.-Vakeri-mula, M.-Nuni-gatcha); astrin., in phthisis and scrofulous affections.

C. nuga Ait. (M.-Kakumullu); roots—diur., tonic., useful in gravel and stone in bladder.

C. pulcherrima Swartz. (B.-Krishnachura, M.-Ratnagandi).

C. sappan Linn. (S.-Pattánga, H. & B.-Bakam, Patang, M.-Patanga); emmen.; brasilin, essen. oil; Schim. Ber., 1929, 7.

C. sepiaria Roxb. (H.-Relu, Arlu, P.-Arlei, Bo.-Chillur).

Cajanus indicus Spreng.; Leguminosæ; (S.-Adhaki-tubarika, H., B. & P.-Arhar, Bo.-Tuver, M.-Tuvvar); in snake-bite.

Calamintha clinopodium Benth.; Labiatæ; (Arab.-Asába-el-fátiyat); astrin., carmin. and heart tonic.

Calamus draco Willd.; Palmæ; Dragon's blood (H. & Bo.-Hiradukhi); stomch., astrin.; gum—dragon; Arch. Pharm., 1896, 401.

C. rotang Linn. (S.-Vetasa, H., B. & Bo.-Bet, M.-Bettam); in snake-bite.

C. travancoricus Bedd.; Palmeæ; (S.-Vethra, M.-Pirambu); tender leaves—used in biliousness, worms, dyspep. and ear-disease.

Calendula officinalis Linn.; Compositæ; (P.-Zergul); astrin., styptic; salicylic acid, bitter substance—calendulin, essen. oil; Jr. Pharm. Chim., 1904 (6), 121; Z. Physiol. Chem., 1927, 229.

Calla aromatica Roxb.; Aroideæ; (Kuchoo gundubee); stim.; O'shaughnessy, Beng. Disp.

Callicarpa arborea Roxb.; Verbenaceæ; (B.-Khoja, Makanchi, Bo.-Ghivala); bark—arom., bitter, tonic, carmin.

C. lanata Linn. (H.-Bastra, B.-Massandari, Bo.-Aisar); emol., useful in fever, hepatic obstruction and herpetic eruptions.

C. macrophylla Vahl. (B.-Mathara, P.-Sumali); in rheum.

Calligonum polygonoides Linn.; Polygonaceæ; (P. & Bo.-Tirni).

Callitris quadrivalvis Vent.; Coniferæ; chr. diar.

C. inophyllum Linn.; Guttiferæ; (S.-Punnága, H.-Sultana champa, B.-Punnag, Bo.-Undi, M.-Punnagam); oil of seeds—specific for skin diseases.

C. tomentosum Wight.

Calophy lum wightianum Wall. (Bo.-Sarpuna, M.-Cheru-pinnay); resin—antiphl., anodyne; oil of seeds—in leprosy and cutaneous affections; bitter oil; Jr. Ind. Inst. Sci., 1923, 133.†

Calotropis gigantea R. Br.; Asclepiadeæ; (S.-Arka, H.-Ak., B. & Bo.-Akanda, M.-Erukku); root bark—in worms, ascites, skin diseases, milky juice—purg. and used as cattle poison; bitter resins akundarin, calotropin; Merck's Index, 1929, 370; J. C. S., 1915, 1437.*

C. procera R. Br. (S.-Alarka, H.-Madar, P.-Shakar-al-lighal, Bo.-Mandara, M.-Vellerku); Compt. Rend. 1913, 600.

Caltha palustris Linn.; Ranunculaceæ; (P.-Mamiri, Baringu); roots—poisonous; helleborin and veratrine; Chem. Ztg., 1917, 61; Arch. Pharm. 1910, 463; Chem. News. 1916, 295.†

Calycopteris floribunda Lamk.; Combretaceæ; (H.-Kokoranj, Bo.-Ukshi, M.-Marsada boli); bitter, astrin., anthelm., laxt., in colic and snake-bite.

Camellia theifera Griff.; Ternstrœmiaceæ; (H., B., P. & Bo.-Chá); stim., diur.; caffeine, xanthine, theophylline, saponin; Ber. 1885, 79; 1930, 1890, 225; Ber. Pharm. Ges. 1901, 339; Jr. Assoc. Agri. Chem. 1923, 154; Arch. Pharm. 1901, 363.*

Cananga odorata Hk. f. & T.; Anonaceæ.

Canarium bengalense Roxb.; Burseraceæ; (B.-Dhuna); resin.

C. commune Linn. (H.-jangli-badam, Bo.-Jangali-badana, M.-Kagli-mara); resin—subst. for Mixtura amygdalæ; laxt., demulc., stim., expect.; essen. oil—anethol; Bull. Imp. Inst., 1921, 459; 1922, 496.†

C. pimela (Chin-Wu-lan); astrin, sialog., stomch.; Chinese Mat. Med.

C. strictum Roxb. (H. & B.-Kala-dammar, Bo.-Dhup, M.-Karuppu-damar); resin—used for making plaster; in chr. skin diseases; essen. oil; Jr. Soc. Chem. Ind., 1925, 169.†

Canavalia ensiformis DC.; Leguminosæ; (M.-Kattuvalari); fruits—eaten create abdominal complaints, hernia and colic; cystin, tyrosin, tryptophan, etc., and alk.; Jr. Biol. Chem., 1914, 449; 1916, 67; 1925, 257.†

C. virosa W. & A.; (B.-Kath-shim, Bo.-Kudsumbar); narcotic.

Canna indica Linn.; Scitamineæ; (S. & B.-Sarvajaya, H.-Sabbajaya, P.-Hakik, Bo.-Deva keli, M.-Kandamani-cheddi); root—diaphor, diur.*

Cannabis sativa Linn.; Urticaceæ; (S.-Ganjiká, H., B. & Bo.-Gánjá, M.-Bhangi); stomch., antisp., analgesic and anodyne; cannabinol, pseudo-cannabinol, cannabinin; Arch. Exp. Path. Pharm. 1903, 266; Pharm. Act. Helvet, 1926, 210; J. C. S., 1896, 539; Proc. Chem. Soc. 1898, 44; Bull. Sc. Pharm. 1924, 321.*

Canscora decussata Rœm. et. Sch.; Gentianaceæ; (S.-Sankhapuspi, H.-Sankháphuli, B.-Dankuni, Bo.-Shunkhapushappi); laxt., alter., nerve tonic.

C. diffusa Br. (Burm.-Kyouk pan); subst. for C. DECUSSATA.

Canthium didymum Roxb.; Rubiaceæ; (Santh.-Garbha gogha, M.-Yerkoli); bark—used in fever.

C. parviflorum Lamk. (Bo.-Kirni, M.-Bálusu).

Capparis acuminata Roxb.; Capparideæ; (H.-Govindphal, B.-Kalukera, M.-Anthundi-kai); cooling.

C. aphylla Roth. (S.-Karira, H.-Karer, P.-Karia, Bo.-Kari, M.-Karyal); counter-irrit.

C. heyneana Wall. (H.-Chayruka); leaves—in rheum., flowers—laxt.

C. horrida Linn. (S.-Hankaru, H.-Ardanda, M.-Alanday); counter-irrit.

C. sepiaria Linn. (S.-Kakdani, B.-Káliakará).

C. spinosa Linn. (S.-Kakadani, H. & P.-Kabrá); in palsy, dropsy, gout, rheum.; glucd. rutin; Arch. Pharm. 1904, 210.

C. zeylanica Linn. (H.-Govindaphal, B.-Kálu-kera, M.-Anthundi-kai); sedative and diur.

Capsella bursa pastoris Mœnch.; Cruciferæ; antiscor., in hæmaturia and dropsy; alk. bursine, saponin; Pharm. Ztg., 1888, 52, 151; Pharm. Centralh. 1919, 237; Apoth. Ztg. 1921, 359.†

Capsicum annuum Linn.; Solanaceæ; (H. & P.-Mirch); in snake-bite; capsicin, capsaicin, solanine; Arch. Pharm. 1892, 108; J. C. S. 1919, 1109; C. C. 1884, 577.

C. cerasiforme Lamk.

C. frutescens Linn.

C. grossum Willd

C. minimum Roxb.; capsicin; Jr. Ind. Engin. Chem. 1910, 419.

Carallia lucida Roxb.; Rhizophoreæ; (M.-Vallabhom); fruits—used in contagious ulcers.
Caralluma attenuata Wight.; Asclepiadeæ.
Carapa moluccensis Lam.; Meliaceæ; (B.-Pussar); bitter, astrin., used in colic, diar.
Cardamemon magus; Scitamineæ; imported.
Cardanthera uliginosa Ham.; Acanthaceæ; leaves—blood purifier.
Cardiospermum halicacabum Linn.; Sapindaceæ; (S.-Karnaspota, H.-Kanaphata, B.-Lataphatkiri, M.-Mooda cottan); emetic, laxt., stomch., used in amenor. and snake-bite; saponin.
Carduus nutans Linn.; Compositæ; (P.-Konchari); febge.
Careya arborea Roxb.; Myrtaceæ; (S., H. & B.-Kumbhi); astrin., demulc. used in snake-bite.
Carica papaya Linn.; Passifloreæ; (H.-Papaya, B.-Papey, Bo.-Papai M.-* Pappayi); juice of unrise fruits—anthelm; carpaine, carposide, papain; Ber. 1890, 3537; Arch. Pharm. 1893, 184; 1897, 332; Phil. Jr. Sci. 1915, 1.*
Carissa carandas Linn.; Apocynaceæ; (H.-Karaunda, B.-Karancha, M.-Kalaka); antiscor.; alk., salicylic acid; Pharm. Ind., Vol. II, 420.
C. spinarum A. DC. (S.-Karamadika, H.-Karaunda).
Carpesium abrotanoides Linn.; Compositæ; (Kash.-Wotiangil, P.-Hukmandáz).
Carthamus oxycantha Bieb.; Compositæ; (P.-Kantiari).
C. tinctorius Linn. (H. & B.-Kusum, S. & M.-Kusumba); seeds—purg., used in rheum.; flowers—in jaundice; colouring matter carthamin; *Jr. Soc. Chem. Ind., 1898, 969; 1919, 36; J. C. S., 1910, 1415; Oil* and Fat Industry, 1929, No. 4, 11.
Carum bulbocastanum Koch.; Umbelliferæ; (H.-Kalajira, Kash.-Guniyun); use same as C. CARUI.
C. carui *Linn. (H.-Shiajira, B.-Jira, M.-Shimai-shombu)*; stomch., carmin.; essen. oil.; Schim. Ber. 1925, 43; Analyst, 1909, 519.*
C. copticum Benth. (S.-Yamani, H. & Bo.-Ajowan, B.-Jowan, M.-Oman); anthelm., antisep., carmin.; essen. oil, thymol; Schim, Ber. 1903, Oct. 82; 1920, 3; 1928, 14; Jr. Soc. Chem. Ind. 1918, 604.*
C. roxburghianum Benth. (H.-Ajmud, B.-Randhuni); carmin., stomch.
Caryophyllus aromaticus Linn.; Myrtaceæ; (S. & B.-Lavanga, H.-Laung, Bo.-Lavang, M.-Kirambu); carmin., in snake-bite; essen. oil, eugenol; Analyst, 1909, 519; Schim. Ber. 1912, April 92.; 1928.*
Caryota urens Linn.
Casearia esculenta Roxb.; Samydaceæ; (H.-Chilla, M.-Kaddla shingi); cath., promotes action of liver.
C. graveolens Dalz. (H.-Chilli, Bo.-Naro); fruit—fish poison; leaves—poisonous.
C. tomentosa Roxb. (H.-Chillara); fish poison.
Cassia absus Linn.; Leguminosæ; (H.-Chaksu, M.-Karun Kanam); seeds—astrin., in conjunctivitis; alk.
C. alata Linn. (B.-Dadmari); in snake-bite; chrysophanic acid; Apoth.-Ver. 1887, 589.
C. angustifolia Vahl.; (H.-Hindisana, B.-Sonamukhi, M.-Nila vakai); laxt., purg.; glucd., kampferin, anthraquinone, essen. oil; chrysophanic acid, iso-rhamnetin; Ca-oxalate 12% in leaves; Jr. Phys. 84, 281; Arch. Pharm. 1900, 427; J. S. S., 1913, 2006.*
C. auriculata Linn. (H. & B.-Tarwar, M.-Avirai); in ophthalmia and conjunctivitis; seeds—in diabetes and chylous urine; Jr. Ind. Soc. Leather Trades. Chem. 1928, 53.
C. burmanni Wight (B.-Jijan); subst. for senna.
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Cassia fistula Linn. (S.-Aragbadha, H.-Amaltash, B.-Sondali, M.-Konraik-kai); fruit—cath., applied in rheum. and snake-bite; C. C. 1911, I, 1314.
C. glauca Lam. (M.-Konda-tantepu-chettu, Sing.—Wal-ahalla); bark—in diabetes and gonor.; glucd., chrysophanic acid; Ber. 1890, 3537. †
C. mimosoides Linn. (Santh.-Patwa-ghas); roots—in spasms of stomach.
C. obovata Linn. (Bo.-Surati sonnamukai); oxymethyl-anthraquinones; Pharmacogn., 1917, 1404; Bull. Sc. Pharm. 1927, 10.
C. obtusifolia Linn. (H. & B.-Chakunda); emodin.; Apoth.-Ztg. 1896. 537.
C. occidentalis Linn. (H.-Kasondi, B.-Kalkashunda, M.-Pera-verai); febge., purg., used in snake-bite, emodin, oxymethyl-anthraquinones, toxalbumin; Apoth.-Ztg. 1896, 537; Compt. Rend. Soc. Biol. 1925, 862.†
C. siamea Lam.; alk.; Phil. Jr. Sci., 1919, 1.
C. sophera Linn. H.-Kasunda, B.-Kalkashunda; in snake-bite; emodin, chrysophanic acid; Apoth.-Ztg., 1896, 537.
C. tora Linn. (S.-Chakramarda, H. & B.-Chakunda, M.-Tagarai); in skin diseases and snake-bite; emodin, glucd.; Pharm. Jr., 1889, 242. †
Cassytha filiformis Linn.; Laurineæ; (S.-Akasavalli, H.-Amarbeli, B.-Akasbel); in bilious affections, urethritis and skin diseases; alk, 0.1%; Meded. Lands Plantent, 1898, 23.
Casuarina equisetifolia Forst.; Casuarinaceæ· (H.-Janglijhau, B.-Belati-jau); wood and bark—astrin.; leaves—in colic; colouring matter-casuarin; Pharm. Centralh., 1884, 417.
Catabrosa aquatica Beauv.; Gramineæ; HCN-glucd.; Jr. Pharm. Chim. 1908, (6) 542.
Catarus spiciflorus Linn.; diar.
Cedrela toona Roxb.; (S. & B.-Nandibriksha, H.-Tun, Bo.-Tuni, M.-Tunumaram, P.-Khusing); bark—astrin., tonic, antiper., flowers—emmen.; bitter substance—nyctanthin; Repert. Chim. Appl. Pur., 1860, 72; J. C. S., 1912, 1538.
Cedrus libani Barrel.; Coniferæ; (S. & B.-Devadaru, H.-Deodar, P.-Pahadi-keli); in fever, flatulence, dropsy, rheum., piles, gravels in kidney, snake-bite; gum, cholesterin, essen. oil; Schim. Ber., 1892, April, 41; 1923, 49; 1909, Oct. 130.†
Celastrus paniculata Willd.; Celastrineæ; (S.-Kanguni, H.-Malkanguni, M.-Valuluwai); in rheum., leprosy, paralysis: alk., glucd. colouring matter; Bull. Inst. Bot Buitenzorg., 1902, 17.†
C. senegalensis Lam. (H.-Gajachini); in snake-bite.
C. spinosa Royle. (H.-Faliddhar, P.-Kandiari); smoke from seed good for toothache.
Celosia argentea Linn.; Amarantaceæ; (H.-Sufed murgha, B.-Swet-murgha); seeds—in diar.; Compt. Rend. 1888, 902.
C. cristata Linn. (S.-Mayur sikha, H.-Kokan, B.-Lál-murgá, P.-Mawal); flowers—in diar. and excessive menstural discharges; seeds—demulc., in *painful micturition*; Pharm. Post. 1896, 189.
Celsia coromandeliana Vahl.; Scrophularineæ; (S.-Kulahala, B.-Kunshima); sedative, astrin., in diar., dysen.
C. caucasica Willd. (P.-Brimla); fruit—in amenor.
C. cinnamomea Lindl. (Sing.-Gurenda); bark—blood-purifier in skin eruptions; scatol; Apoth. Ztg., 1895, 346.
Celtis orientalis Linn.; Urticaceæ; N. Sen, Ayur. Med.; Prain, Beng. Plants.
C. reticulata Hk. f & T.; alk.; Proc. Roy. Soc., 1890, 211.
Centaurea behen Linn.; Compositæ; (Ind. Baz.-Safed bahman); aphrodis., used in jaundice and calculus affections; cryst. alk.—bahamine;

Centaurea cyanus Linn.; glucd. chichorigenin; Arch. Pharm. 1876, 327.
Centipeda orbicularis Lour.; Compositæ; (S.-Chhikika, H.-Nakkchikni, B.-Mechulta); in headache and cold; essen. oil, amorph. bitter substance; Oesterr. Apoth. Ver., 1878, 489.
Cephalandra indica Naud.; Cucurbitaceæ; (S.-Bimba, H.-Kandnri-ki-Bel, B.-Telákuchá, Bo.-Bhimb., M.-Kovai); in diabetes; I. J. M. R., 1925, 11.
Cerasus caproniana Rosaceæ; (Kash.-Aloo-baloo); O'Shaughnessy, Beng. Disp.
Ceratonia siliqua Linn.; Leguminosæ; pods—purg., astrin., used in cough, Arch. Pharm. 1846, 295; Compt. Rend. 1900, 623; Bull. Sc. Pharm. 1922, 369; Monatsh. Chem. 1927, 479.†
Cerbera odollam Gærtn.; Apocynaceæ; (B.-Dhakur, M.-Katarali); used as animal poison; glucd.—cerberin; bitter substance odollin; Ber., 1890, 3455; Jr. Ind. Inst. Sci., 1927, 20; Arch. Pharm. 1893, 10.
C. thevetia Don.; antiperiodic; Birdwood, Veg. Prod. Bombay
Cerevisiæ fermentum. Yeast plant; used as poultice in inflam.
Ceriops candolleana Arn.; Rhizophoreæ, astrin., bark—hæmostatic; shoot—subst. for quinine; Jr. Soc. Chem. Ind. 1917, 188.
Ceropegia bulbosa Roxb.; Asclepiadeæ; (H.-Khappar kadu, Bo.-Patal-atum bari); tonic, digest.; alk. ceropegine; Pharm. Ind. Vol. II, 457.
C. juncea Roxb.
C. pusilla Wight. (M.-Killango).
C. tuberosa Roxb. (P.-Galot, Bo.-Khappar kadu, M.-Manda); tonic for children.
Chamærops ritchieana Griff.; Palmæ; Leaves—in diar., dysen.
Cheiranthus cheiri Linn.; Cruciferæ; (H.-Todrisurkh, B.-Khueri); emmen., alk. cheirinine, glucd. cheirolin, cheiranthin; Arch. Exp. Pharm., 1898, 302; essen. oil; Schim. Ber., 1911, Oct. 47; Chem. Ztg., 1911, 667; 1908, 76; Ann. Chem. 1910, 207; J. C. S., 1896, 1566.†
Chenopodium album Linn.; Chenopodiaceæ; (S.-Vastuk, H.-Chandan betu, B.-Bathu sag, Bo.-Chakwit, M.-Parupu kire); anthelm.; essen. oil; Arch. Pharm. 1893, 641 and 648.†
C. ambrosioides Linn.; anthelm; essen. oil; Schim. Ber. 1891, April, 49; 1920, 59; 1921, 15; 1922, 17.†
C. botrys Linn.; anthelm.; essen. oil.†
C. blitum *Hk. f.*, C. glaucum *Linn.*, C. hybridum *Linn.*, C. murale *Linn.* and C. opulifolium *Schrad.* have not been investigated.
Chickrassia tabularis Juss.; Meliaceæ; (B.-Chikashi); astrin.
Chironia centaurioides Roxb.; Gentianaceæ; (B.-Girmi); Chinese Mat. Med.
Chloranthus inconspicuus Linn.; Chloranthaceæ; (Chin.—Chin-chu-lan); Chinese Mat. Med.
Chlorophytum arundinaceum Baker.; Liliaceæ; (H.-Safed-musli); tonic.
C. breviscapum Dalz. (Sing.-Bhimpal).
Chloroxylon swietenia DC.; Meliaceæ; (H.-Bhivia, M.-Vummaay); irrit.; alk. chloroxylonine, chloroxyline; J. C. S. 1909, 964; Meded. Lands Plantent. 1899, 105, 131; B. M. J., Oct. 7, 1911.
Chondrus crispus Lyngbye.; Algæ; stim., sudorific; Murray, Drugs of Sind.
Chonemorpha macrophylla G. Don.; Apocynaceæ; H.-Garbedero, B.-Harki); alk. 0.15%; Wehmer, Pflanzen-stoffe, 985, 3367.
Chrozophora plicata A. Juss.; Euphorbiaceæ; (H.-Shahdevi, Bo.-Khudi-okra, P.-Nilkanthi); alter., in leprosy.

Chrozophora tinctoria A. Juss. (H.-Subali, P.-Kukronda); emetic, poisonous, colouring-matter turnsole; Pharmacogn. III, Abt. 2, 903.

Chrysanthemum coronarium Linn.; Compositæ; (H.-Gulchini, B.-Guldandi); in gonor.; adenine, chlonine; Z. Physiol. Chem. 1913, 334.

C. indicum Linn. (H.-Gundandi, Bo.-Akurkura); gonor., essen. oil, glucd. chrysanthemin; Bull. Soc. Chim., 1900, 216; Ann. Chem. 1916, 136; Ber. 1928, 2503.†

Chrysophyllum roxburghii Don.; Sapotaceæ; alk.; Bull. Inst. Bot. Buitenzorg., 1902. XIV. 30.

Cicer arietinum Linn.; Leguminosæ; (H.-Chana, B.-Chhola, M.-Kadalai); acid exudation in dyspep., constip. and snake-bite; oxalic, acetic, malic and another acid, As—0,009 mg. in 100 g. seeds; Compt. rend. 1912, 893; Pharm. Ind., Vol. I, 488.

Cichorium endivia Linn.; Compositæ; resolv., cooling and used in bilious complaints; a bitter substance; Monatsh. Chem. 1926, 694.

C. intybus Linn. (H., B. & Bo.-Kasni); glucd. cichoriin, bitter substances lactucin, intybin, As—0,01 mg. in 100 g. root; C.C. 1912. I. 1730; Arch. Pharm. 1876, 327; Monatsh. Chem. 1926, 695, Arch. Hyg., 1913, 210.†

Cimicifuga fœtida Linn.; Ranunculaceæ; Bugbane (P.-Jiunti); nerve depressant; alk. cimicifugine; Amer. Jr. Pharm., 1878, 468; 1884, 459.

C. racemosa Linn.; alk. cimicifugine; Amer. Jr. Pharm. 1878, 468; Pharm. Jr. 1909, 145; 1910, 142.

Cinchona calisaya Weddell.; Rubiaceæ; Pharm. Post. 1906, 345; Pharm. Jr. *1864, 16; 1920, 22.**

C. ledgeriana Mœns.; specific for malaria; Ann. Chem. 1881, 288; Bull. Imp. Inst. Lond. 1920, 22.

C. officinale Hook.; specific for malaria; Pharm. Jr. 1888, 288; Ber. 1873, 1129; 1881, 1890.*

C. robusta How.; specific for malaria; Pharm. Weekbl. 1917, 1225; Bull. Imp. Inst. Lond. 1928, 17.

C. succirubra Pavon.; specific for malaria; Pharm. Jr. 1873, 121; 1878, 324; 1883, 897; Jr. Pharm. Chim. 1879, 330; Pharm. Post. 1906, 345.*

Cinnamomum aromaticum Nees.; Laurineæ; carmin.; essen. oil; Schim. Ber., 1892, Oct. 12; 1896, Oct. 11; 1910, April, 27; Jr. Amer. Pharm. Assoc. 1923, 294.

C. camphora F. Nees.; stim., carmin.; essen. oil; Jr. Soc. Chem. Ind. 1920, 296; Schim. Ber. 1906, Oct. 40; 1907, April, 64, 1918, 14; Bull. Imp. Inst. 1928, 294.*

C. cassia Blume.

C. glanduliferum Meissn. (Assam.—Gunserai, Nep.-Malligiri); stim., carmin.; essen. oil; Schim. Ber. 1923, 145; Bull. Sc. Pharm. 1919, 204.

C. iners Reinw. (Bo.-Tikhi, M.-Káttu-karuváppattai); essen. oil; Pharm. Jr. 1912, 145.

C. loureirii Nees, (Chin.-Ohin-kio-kiu); Chinese Mat. Med.

C. macrocarpum Hook.

C. nitidum Blume.

C. obtusifolium Nees. (B.-Tejpat, Nep.-Bara-singoli).

C. parthenoxylon Meissn. (M.-Kavo-gadis); essen. oil; Schim. Ber. 1912, April, 39; Bull. Imp. Inst. Lond. 1925, 421.

C. tamala Fr. Nees. (S.-Tamál, H.-Dálchini); bark—carmin., leaves—in scorpion-sting; essen. oil; Schim. Ber. 1910, April, 124.

C. zeylanicum Breyn. (S.-Gudatreaka); carmin.; essen. oil; Schim. Ber. 1916, 98, Chem. & Drug. 1926, 667, Bull. Imp. Inst. 1918, 146; 1919, 189.*

Fifteen species of Cinnamomum are uninvestigated.

Cirsium arvense Scop.; Compositæ; alk.; Amer. Jr. Pharm., 1896, 529; leaves—HCN-glued.; Jr. de Pharm. 1908, 542.
Cissampelos pareira Linn.; Menispermaceæ; (S.-Patha, H. & B.-Nirbisi); in dyspep., diar., dropsy, in snake-bite; alks. sepeerine, bebeerine, cissampeline; Amer. Jr. Pharm., 1870, 430; Pharm. Jr. 1844, 284.
Citrullus colocynthis Schrad.; Cucurbitaceæ; (S.-Indra-varuni, H. & Bo.-Indrayan, B.-Mákhál, M.-Peyt-tumatti); antid. to snake poison, in dropsy, dysen., amenor, drastic purg.; bitter substance, colocynthin, colocynthetin; Amer. Jr. Pharm. 1893, 179, Pharm. Jr. 1907, 117; Arch. Pharm. 1883, 201.
C. vulgaris Schrad. (H.-Tarbuz, B.-Tarmuj); seeds—diur.; citrullin; Biochem. Ztscher. 1929, 267; Ber. 1930, 2881; Bull. Imp. Inst. Lond. 1916, 160; 1925, 145.
Citrus aurantium Linn.; Rutaceæ; (H.-Narengi, B.-Kamala nebu); As—0,011 mg. in 100 g.; 1912, 893 (C.C. 1912, I. 1730).
Var. bergamia *W. & A.* and bigaraia *Brandis*.
Citrus decumana Linn. (H. & B.-Batavi nembu, P.-Chakotra, M.-Bombalinas); fruit—nutri., refrig., leaves—useful in epilepsy, cholera and convulsive cough.
C. decumana var. acida *Roxb.*
C. lemonum Sp. Risso.
C. limetta W. & A.
C. medica *Linn.*; *in scorpion-sting and snake-bite.*
Cleistanthus collinus Benth.; Euphorbiaceæ; (M.-Nachuta); extremely poisonous, bark—fish poison; saponin; Pharm. Weekbl. 1909, 16; alk.; Pharm. Ind., Vol. III, 271.
Clematis gouriana Roxb.; Ranunculaceæ; juice—vesic., poisonous.
C. nepalensis DC. (P.-Oandak); leaves—deleterious to skin.
C. triloba *Heyne.* (*S.-Laghukarni, H. & Bo.-Moravela*); *in* leprosy, blood diseases, fevers and snake-bite.
Cleome felina Linn.; Capparideæ; (S.-Swarnakshira); astrin.
C. pentaphylla Linn.; (S.-Carvella, H.-Karaila, B.-Hurhuria); stim.
C. viscosa Linn.; (S.-Arkakanta, H.-Káuphuti, B.-Hoorhooria, M.-Naivela); seeds—carmin., anthelm.
Clerodendron inerme Gærtn.; Verbenaceæ; (S.-Kundali, H.-Binjcam, B.-Bonjoi, M.-Pinasangam koppi); alter., febge., resembles chiretta.
C. infortunatum Gærtn. (H. & B.-Bhant, Bhat); laxt., cholag., anthelm., used in scorpion-sting and snake-bite; bitter principle.
C. phlomoides Linn. (S.-Vata-ghin, H. & Bo.-Urni); alter. and bitter tonic.
C. serratum Spreng. (*H.-Barangi*); *used in snake-bite and fever*; *alk.*; Bull. Inst. Bot. Buitenzorg. 1902. Nr. XIV. 35; Meded. Lands Plantent 1900, 13.
C. siphonanthus R.Br. (S.-Bhargi, H.-Bhárangi, B.-Bamunhati, P.-Arni); root—useful in asthma, cough, etc.; alk.; Bull. Inst. Bot. Buitenzorg. 1902. Nr. XIV. 35; Meded. Lands Plantent 1900, 13.
Clitoria ternatea Linn.; Leguminosæ; (S.-Aparajita, H. & B.-Aparajit, (M.-Kakkanan); roots—aper., diur., used in snake poisons.
Cocculus laurifolius DC.; Menispermaceæ; tox. alk.; coclaurine; Jr. Pharm. Soc., Japan, 1925, Nr. 524. 3.
C. leæba DC.; (P.-Ullar-billar, Bo.-Parvati); tonic, similar to TINOSPORA CORDIFOLIA.
C. macrocarpus W. & A.; leaves—powdered and taken in milk cure syphilis, biliousness and gonor.
C. villosus DC. (H.-Jamti-ki-bel); laxt., sudorific, useful in rheum. and gonor.
Cochlospermum gossypium DC.; Bixineæ; (H.-Pilikapas, M.-Tanaku); gum—subst. for tragacanth.

Cocos nucifera Linn.; Palmæ; (S.-Narikela, H.-Nariyal, B.-Narikel, M.-Tanba); water of unripe fruit—cooling in urinary disorders; root—diur. and used in uterine diseases; enzyme—invertin, oxydase, catalase; Bull. Dept. Agri. Indes. Neerl. 4. 1907. Chem. Ztg. 1900, 16; Analyst, 1924, 223; Pharm. Centralh. 1906, 1045; Jr. Soc. Chem. Ind. Lond. 1916, 1138.†

Codonopsis ovata Benth.; Campanulaceæ; (P.-Ludut); roots and leaves—used for bruises, ulcers.

Coffea arabica Linn.; Rubiaceæ; (H.-Coffee, B.-Kafi); stim., diur.; alk. caffeine, adenine, xanthine, hypoxanthine, guanosine; J. C. S. 1856, 33; Arch. Pharm. 1851, 148; Jr. Biol. Chem. 1924, 831, Apoth. Ztg. *1893, 443.*

C. bengalensis Roxb.

C. fragrans Korth.

C. jenkinsii Hook.

C. khasiana Hook.

C. travancorensis W. & A.

C. wightiana W. & A.

Coix lachryma Linn.; Gramineæ; (S.-Gavedhu, H.-Gurlu, Bo.-Gurmur, P.-Sanklee); blood purifier; root—used in menstrual disorders, leucin, tyrosin, histidin, lysin, arginine, coicin; Jr. Biochem. Kyoto, 1922, 365.†

Colchicum luteum Baker.; Liliaceæ; (vern.-Surinjan); subst. for C. AUTUMNALE; in gout.*

Coldenia procumbens Linn.; Boragineæ; (S.-Tripakshee, H.-Tripungkee, Bo.-Bursha); leaves—applied to rheumatic swellings.

Colebrookea oppositifolia Sm.; Labiatæ; (H.-Pansra, P.-Shakardáná, Nep.-Dosul); roots—in epilepsy.

Coleus aromaticus Benth.; Labiatæ; (H.-Patharcheer); in colic and dyspep.; essen. oil carvacrol; Schim. Ber., 1919, 15; 1922, 19; Pharm. Weekbl. 1915, 253.†

Colocasia antiquorum Schott.; Aroideæ; (H. & B.-Kachoo); styptic, stim., rubft., in scorpion-sting; Amer. Jr. Pharm. 1919, 498.

C. macrorrhiza Schott. (S.-Hastikarni); in fevers.

C. virosa Kunth; (Bish Kachu).

Colutea arborescens Linn.; Leguminosæ; (P.-Bráa); leaves—purg.

Combretum decandrum Roxb.; Combretaceæ; (H.-Punk).

C. nanum Ham. (P.-Dantjalhi).

Commelina bengalensis Linn.; Commelinaceæ; (S.-Kanchata, H. & B.-Kánchara, M.-Kanang Karai); demulc., refrig., laxt.

C. nudiflora Linn.; (M.-Vazhapazhathi); bruised plant applied to burns, itches and boils.

C. obliqua Ham. (H.-Kanjura, B.-Jata Kanchura); antid. to snake poison, useful in vertigo, fever and bilious affections.

C. salicifolia Roxb.; used in dysen., insanity.

C. suffruticosa Bl. (Santh.-Dareorsa); applied to sores.

Conium maculatum Linn.; Umbelliferæ; (Ind. Baz.—Kurdumána); neurotic in painful affections of skin, aphrodis.; alk., d-coniine, γ coniceine, conhydrine, n-methyl coniine, hesperidin; Pharm. Jr., 1904, 185; Jour. Prakt. Chem., 1928(2), 25; Ber., 1894, 2615; 1895, 302; 1902, 1330.†

Connarus monocarpus Linn.; Connaraceæ; (M.-Kuriel); pulp of fruit used in eye diseases, decoct. of root in syphilis.

Convolvulus arvensis Linn.; Convolvulaceæ; (H.-Hiranpadi, Bo.-Hiranpag, M.-Naranji); root—purg.; convolvulin; Pharm. Ind., Vol. II, 543.

Coptis teeta Wall.; Ranunculaceæ; (H.-Mamira, B.-Tita, Bo.-Mahmira); bitter tonic, applied on sores; berberine, coptine; Pharm. Jr. 1912, 482; Amer. Jr. Pharm. 1873, 193; Arch. Pharm. 1884, 747.*

Corallocarpus epigæa Hook.; Cucurbitaceæ; (S.-Patalagaruda, H.-Akas-gaddah, M.-Akash garudand); in dysen. and snake-bite; bitter principle like bryonin.
Corchorus antichorus Rœusch.; Tiliaceæ; (Bo.-Baphali); demulc., used in gonor.
C. capsularis Linn. (S.-Nadika, H. & B.-Pát, M.-Pirattikerai); leaves—demulc., bitter tonic, used in dyspep. and liver disorders; glucd.-capsularin, corchorin; J. C. S., 1922, 1044; Merck's Index, 1929, 383; Jr. Ind. C. S., 1927, 205; 1928, 759.†
C. fascicularis Lam. (Ind. Baz.-Bhaphali, Bo.-Hirankhori); astrin., restor.
C. olitorius Linn. (H.-Koshta, B.-Nalitapat); in fever and dysentery.
C. trilocularis Linn.; seeds—in fever.
Cordia angustifolia Don.; Boragineæ; (H.-Goond, Goondnee); Birdwood, Veg. Prod. Bombay.
C. latifolia Roxb. (S.-Sheloo, H.-Bara lesoora, B.-Buro bahuri); Birdwood, Veg. Prod. Bombay.
C. macleodii Hook. f. & Th. (H.-Dahipalas); in jaundice.
C. myxa Linn. (H.-Chokargond, B.-Buhul, Bohodani); mild tonic.
C. obliqua Willd. (H.-Chotalasora, B.-Bahubara, M.-Naruvili); demulc., used in snake-bite and affections of urinary passages.
Cordia rothii Röm & Schult. (H.-Gondi); decoct. of bark—astrin., used as gargle.
C. vestita Hook. f. & Th. (H.-Kumpaiman, P.-Kumbi); astrin.
Coriandrum sativum Linn.; Umbelliferæ; (S.-Dhanyaka, H. & B.-Dhania, M.-Kattamalli); carmin., diur., tonic, infusion used in chr. conjunctivitis; essen. oil; Schim. Ber., 1924, 20; 1892, April, 11; Jr. Ind. Inst. Sci., 1925, 182; Schim. Ber., 1926, 23; 1925, 17; Bull. Imp. Inst. 1917, 301.†
Coriaria nepalensis Linn.; Coriareæ; (H.-Makola, P.-Gúch, Nep.-Raselwa)
Corydalis cashmeriana Royle; Fumariaceæ.
C. govaniana Wall.; (S.-Bhutakesi, H. & B.-Bhut kesi); in eye diseases, tonic and antiper.
C. ramosa Wall.
About 19 species of Corydalis are uninvestigated.
Corylus avellana Linn.; Cupuliferæ; (H.-Findak); tonic, stomch., aphrodis.; Z. Physiol. Chem. 1886, 316; Jr. Amer. Chem. Soc. 1908, 848.
C. colurna Linn. (P.-Urni, Kash.-Winri); nuts—tonic.
Corypha umbraculifera Linn.; Palmeæ; (S.-Alpayushi, M.-Talipanai); sago is obtained from the pith, fruits—stupefy fish.
Coscinium fenestratum Colebr.; Menispermaceæ; (S.-Daru haridraka, B.-Haldi-gach, M.-Mara-manjal); stomch., tonic used in intermittent fevers, general debility, dyspep., in ulcers and in snake-bite; berberine, saponin, J. C. S., 1867, 187.; Pharm. Jr. 1852, 188; Bull. Inst. Bot., Buitenzorg, 1902, 11.
Cosmostigma racemosum Wight.; Asclepiadeæ; (Bo.-Gharphul, M.-Vattuvalli); cholag., in dyspep. with fever; alk., glucd.; Pharm. Ind. Vol. II, 450.; Hartwich, Neue Arzneidrogen. 1897, 115.
Costus speciosus Sm.; Compositæ; (S.-Kemuka, H. & B.-Keu, M.-Koestam); root—bitter, astrin., stim., anthelm., used in snake-bite; Agri. Ledger, 1906, 69.
Cotoneaster microphylla Wall.; Rosaceæ; HCN-glucd.; Jr. Pharm. Chim., 1906, 537; Compt. Rend., 1906, 451.
C. nummularia Fisch. & Mey.; (Pers.-Siah-chob); aper., expect., stomch.; sugar chirkhestite; Pharm. Ind., Vol. I, 585; Pharm. Jr., 1889, 993.
C. vulgaris Lindl.; HCN; Compt. Rend., 1906, 451.

Cotula anthemoides Linn.; Compositæ; (H. & P.-Babuna); in rheum., infusion as eye wash.

Cratægus oxycantha Linn.; Rosaceæ; (P.-Ban-sangli); oxalic acid; Bot. Centralb., 1927, 11; N. F. 337; young shoots—HCN-glucd.; Oesterr. Bot. Ztschr., 1923. Nr. 1, 56, 69.

Cratæva religiosa Forst.; Cappanideæ; (S.-Varuna, H.-Barun, B.-Tektasak, Bo.-Vayavarna, M.-Maralingam); stomch., laxt., diur. bark—in calculus affections and in snake-bite; saponin; Dragendorff, Heilpflanzen, 1898, 261.†

Crescentia cujete Linn.; Bignoniaceæ; (Ind. Baz.-Kalabash); Aper., cooling and febge.; Ber. Pharm. Ges. 1912, 24.

Cressa cretica Linn.; Convolvulaceæ; (H. & B.-Rudranti, Bo.-Khardi, M.-Uppu-Sanaga); tonic, expect. and antibil; alk.; Pharm. Ind. Vol. II, 546.

Crinum asiaticum Linn.; Amaryllideæ; (S.-Visha-mandala, H.-Pindar, B.-Bara-kanur, Bo.-Nagdowan, M.-Vishamangil); emetic, diaphor., purg.; lycorin.; Bull. Jard. Bot. Buitenzorg. 1920, 352.

C. latifolium Linn. (H. & B.-Sukh-darsan).

C. sp.; (Santh.-Sikyombola).

C. zeylanicum Linn. (B.-Sukh-darsan, Bo.-Gadambikanda); similar to C. ASIATICUM.

Crocus sativus Linn.; Irideæ; (S.-Kumkuma, H., B. & Bo.-Jafran, M.-Kungumapu); stomch., antisp., stim., aphrodis., in snake-bite, used as colouring and flavouring agent; glucd.—crocin, crocetin, picrocrocein, essen. oil; Pharm. Jr. 1908, 267; Arch. Pharm. 1914, 139; Schim. Ber. 1919, 75; Pharm. Centralh. 1923, 148; Jr. Pharm. Belg. 1928, 371.* †

Crossandra undulæfolia Salisb.; Acanthaceæ; (Ind. Baz.-Priya-darsa); aphrodis.

Crotalaria albida Heyne.; Leguminosæ; (H.-Bon methi); root—purg.

C. burhia Hamilt. (P.-Sis, Bo.-Brunnu); leaves—cooling.

C. juncea Linn. (S., H. & B.-San, Bo.-Santág, M.-Shanal); in impetigo, psoriasis, emmen.; Bull. Imp. Inst. Lond. 1921, 452.

C. medicaginea Lamk. (P.-Gulabi).

C. prostrata Roxb. (B.-Chota-jhunjhun, M.-seri-gally-gista); used in derangements of the stomach.

C. retusa Linn. (B.-Bil-jhunjhun, Bo.-Ghagri, M.-Potu-galli-gista); used in scabies and impetigo; alk.; Ber. 1890, 3538; 1899, 214; Arch. Pharm. 1899, 595.

C. sericea Retz. (S.-Ghuntáravá, H.-Jhunjhunia, B.-Pipuli-jhunjhun); in scabies and impetigo; Dragendorff, Heilpflanzen, 312.

Crotalaria striata DC.; alk.; Dragendorff, Heilpflanzen.

C. verrucosa Linn. (S.-Sanapuspi, H. & B.-Jhanjhania, M.-Vatta-killu-killuppai); in scabies and impetigo.

About 68 species of Crotalaria are uninvestigated.

Croton aromaticus Linn.; Euphorbiaceæ; (M.-Vidpune).

C. caudatus Geisel. (B.-Nan-bhantur); leaves—as poultice to sprains.

C. joufra Roxb. (B.-Joufra).

C. malabaricus Bedd.

C. oblongifolius Roxb. (B.-Baragach, H.-Chucka, Bo.-Ganasur, M.-Bhutan-kusam); purg., alter., in snake-bite; alk.

C. polyandrus Roxb. (H.-Hakuna, B.-Danti); same as C. TIGLIUM.

C. reticulatus Heyne. (Bo.-Pandhari); bark—bitter and stomch.

C. tiglium Linn. (S.-Kanakaphala, H.-Jamalgota, B.-Joypal, Bo.-Geyapal, M.-Nerválam); stim., liniment in rheum., drastic purg., in snake-bite; Jr. Pharm. Chim. 1898, 524; J. C. S. 1864, 195; Pharm. Jr. 1905, 479; Arch. Exper. Path. Pharm. 1915, 138.

About 20 species of Croton are uninvestigated.

Cryptocoryne spiralis Fisch.; Aroideæ; (M.-Nattu-alivadayam); in infantile vomiting and fever.

Cryptostegia grandiflora Br.; Asclepiadaceæ; (Bo.-Viláyti-vákhandi, M.-Palai); leaves—toxic; Pharm. Ind. Vol. *II*, *426*; Imp. Inst. Lond. Trop. Agri. *1904*, *463*; *Bull. Pharm. 1891*, *41*.

Cubeba officinalis Miq.; Piperaceæ; see Piper cubeba; stim., expet., in gonor.; essen. oil.; Jr. Soc. Chem. Ind. 1928, 92; Jr. Ind. Inst. Sci. 1925, 159.

Cucumis melo Linn.; Cucurbitaceæ; (S.-Kharvuja, H. & Bo.-Kharbuja, B.-Kharmuj, M.-Vellari-verai); seeds—nutri., diur., whole fruit—useful in chr. eczema.; Jr. Biol. Chem. 1923, 79.

C. momordica Linn. (S.-Ervâru, H.-Phut, B.-Phuti); seeds—cooling.

C. pseudo-colocynthis Royle. (S.-Indrayan, H.-Bishlambhi); bitter substance; Pharm. Jr. 1907, 117.

C. pubescens Roxb.

C. sativus Linn. (S.-Sukasa, H.-Khira, B.-Sasá, Bo.-Kankri, M.-Mullu-vellari); fruit- nutri., demulc., seeds—cooling, diur., fruit—demulc and nutri.; Biochem. Ztscher. 1929, 109; Ber. Bot. Ges. 1928, 582.

C. trigonus Roxb. (S.-Vishala, H.-Bislambhi, M.-Hattut-tumatti); similar to colocynth, used in snake-bite; see C. pseudo-colocynthis.

C. utilissima Linn.; seeds—nutri., diur., in suppression of urine; Ann. Bot. 1892, 195.

Cucurbita maxima Duch.; Cucurbitaceæ; (H.-Mithakaddu, B.-Saphuri Kumra, Bo.-Lal bhopali, M.-Pushini); seed—anthelm., oil—nerve tonic; saponin; Bull. Bot., Gard. Kew., 1909, 397; Jr. Amer. C. S. 1896, 609.

C. pepo DC. (S.-Kurkaru, H.-Safed kaddu, B.-Shádá kumra, Bo.-Kaula, M.-Pottai-gummadi); seeds—anthelm.; leaves—in burns; As—0,009 mg. in 100 g. fruit; Compt. Rend. 1912, 893 (C. C. 1912, I. 1730). J. C. S. 1913, 399; Jr. Amer. C. S. 1910, 346, Pharm. Post. 1918, 561.

Cuminum cyminum Linn.; Umbilliferæ; (S.-Jiraka, H.-Zira, B.-Jira, M.-Shiragam); stim., carmin., used in cookery, sanke-bite; essen. oil; Jr. Ind. Inst. Sci. 1925, 182; Bull Imp. Inst. 1917, 302; Analyst, 1904, 78.[*]

Cupressus sempervirens Linn.; Coniferæ; (H.-Sara, Bo.-Saruboke); wood and fruits—astrin., anthelm..; essen. oil; Trans. Sc. Chem. Pharm. Inst. Moskau, 1925, 93.†

Curanga amara Juss.; Scrophularineæ; febge.; glucd. curagin; J. C. S., 1900, 304; Meded. Lands Plantent. 1897, 73; 1899, 135 (C. C. 1899 II. 991, 1125; 1900, I. 298).

Curculigo orchioides Gærtn.: Amaryllideæ; (S.-Tálmulika, H. & Bo.-Kalimusli, B.-Tálamuli, M.-Nilap-panaïk-kizhangu); in piles, jaundice, asthma, diar., gonor.

Curcuma amada Roxb.; Scitamineæ; (S.-Karpura-haridrá, H.-Amhaldi, B.-Amádá, Bo.-Amba-haladar, M.-Mamidiallam); carmin., stomch., cooling, resembles ginger; essen. oil.

C. angustifolia Roxb. (S.-Tavakshiri, H. & B.-Tikhur, Bo.-Tavakhira, M.-Kua).

C. aromatica Salisb. (S.-Vana-haridrá, H.-Jangli haldi, B.-Banhalud, Bo.-Ran hald, M.-Kasturi-manjal); carmin., in snake-bite; essen. oil, 0.6%; Jr. Soc. Chem. Ind., 1928, T 54; Jr. Ind. Inst. Sci., 1926, 140.†

C. cæsia Roxb. (H.-Kalihaldi, B.-Káláhaldi, Bo.-Nar-kachura); use—same as C. LONGA.

C. longa Roxb. (S.-Haridra, H.-Haldi, B.-Halood, Bo.-Halada, M.-Manjal); arom., stim., tonic, carmin., in conjunctivitis, sprains and wounds; curcumin, alk., essen. oil.; Ber., 1897. 192; J. C. S., 1904, 63; 1907, 1210; Amer. Chem. Jr. 1910, 48; Schim. Ber., 1911, 51; 1922, 20.†

Curcuma leucorhiza Roxb.; (B.-Tikor).
C. montana Rosc. (Bo.-Sinderwani).
C. rubescens Roxb.
C. zedoaria Rosc. (S.-Sati, H. & Bo.-Kachura, B.-Shori, M.-Pulan-kizhanga); root—cooling, diur., arom.; essen. oil; Phill. Jr. Sci., 1909, 132; Schim. Ber. 1911, April, 50.
Cuscuta reflexa Roxb.; Convolvulaceæ; (S.-Amaravela, H.-Akasbel, B.-Algusi, Bo.-Nirmuli, M.-Sitama-purgonalu); seeds—carmin.; anodyne.
Cyananthus sp. Hk. f. & T.; Campanulaceæ; (P.-Murra); flowers—used in asthma.
Cyanotis axillaris Schultes.; Commelinaceæ; (H.-Soltraj, Bo.-Itsaka, M.-Nirpulli); external application in ascites.
C. tuberosa Schultes.; root—used in continued fever.
Cycas circinalis Linn.; Cycadaceæ; (H.-Jangli-madan-mast-ka-phul, M.-Madana kamapu, Bo.-Buzoor butu; stim., aphrodis., narcotic; glucd. pakocin; Pharm. Weekbl., 1903, 309.†
C. revoluta Willd. (Chin.-Wu-lou-tzu); expect., tonic, nutri.; Chinese Mat. Med.
C. rumphii Miq. (M.-Wara-gudu, Malay.-Todda-maram); resin—applied to malignant ulcers; scales—anodyne.
Cyclamen europæum W.; Primulaceæ; (H.-Hathajooree); Birdwood, Veg. Prod. Bombay.
C. persicum Miller. (Ind. Baz.-Bakhur-i-Miryam); emetic, emmen, purg., diur., fish-poison, antid. to snake poison; glucd. saponin cyclamin; Ber., 1879, 374; Arch. Pharm., 1885, 831; Bull. Soc. Chem., 1886, 305.
Cydonia vulgaris Pers.; Rosaceæ; (H.-Bihidana, M.-Shimai-madalaivirai); cardiac tonic, seeds—demulc.; glucd. amygdalin; Tr. N. J. 14, I, 240. glucd. Chem. Ztg. 1887, 1726; Analyst 1902, 133; Ber. 1922, 3038.†
Cylista scariosa Ait.; Leguminosæ; (Bo.-Ranghevada); root—astrin. remedy for dysen. and leucor.; tannins.
Cynodon dactylon Pers.; Gramineæ; (H., B. & Bo.-Doorva, M.-Mooyar-pul); demulc., diur., astrin., hæmostatic, laxt., in scorpion-sting.
Cynoglossum micranthum Desf.; Boragineæ (S.-Adhopuspi, P.-Nilakrai, Bo.-Oudhuphule).
Cynometra ramiflora Linn.; Leguminosæ; (B.-Shingr., M.-Irapu); cath. purg., used in skin diseases.
Cyperus esculentus Retz.; Cyperaceæ (P.-Kaseru); Ber. Pharm. Ges., 1902, 145.
C. inundatus Roxb. (H. & B.-Pati); tubers—tonic and stim.
C. iria Linn. (B.-Buro-choocha); tonic, stim., stomch., astrin.; Chinese Mat. Med.
C. juncifolius klein. (P.-Mutran sialian); stomch., cordiachal.; Stewart, Punj. Plants.
C. rotundus Linn. (S. & Bo.-Mustá, B.-Muthá, M.-Korai); diur., emmen., anthelm., diaphor.; essen oil; Parry, Modern Perfumes, 1926, 21; Jr. Ind. Inst. Sci., 1925, 39. Jr. Soc. Chem. Ind. 1922, T. 172.
C. scariosus Br. (S.-Nágar mustaka, H. & B.-Nágar mothá, Bo.-Lawála, M.-Koraik-kizhangu); similar to C. ROTUNDUS.

Dædalacanthus roseus T. Anders.; Acanthaceæ; (Bo.-Dasmuli); in leucor., promotes growth of fœtus in cattle.
Dæmia extensa R. Br.; Asclepiadeæ; (S.-Phala kantak, H.-Utran, B.-Chágulbánti, Bo. & M.-Utarni); leaves—emetic, expect., used in asthma and snake-bite; bitter glucd.; Hartwich, Neue Arzneidrogen, 1897, 122.

Dalbergia emarginata Roxb.; Leguminosæ; (S.-Krishna sinsapa, B.-Kala sessoo, M.-Kala sinsapa); bitter tonic, stomch., used in leprosy, obesity and worms.

D. junghuhnii Benth.; alk.; Bull. Inst. Bot. Buitenzorg, 1902, 19.

D. lanceolaria Linn. (H.-Bithua, B.-Chakemdia, Bo.-Takoli, M.-Nal valanga); bark—used in intermittent fever.

D. ougeinensis Roxb. (S.-Trinisha, H.-Sandam, B.-Jarul); gum—used in dysen., leprosy, leucoderma, gonor.

D. sissoo Roxb. (S.-Shingshupa, H. & B.-Sisu, Bo. & M--Sissu); leaves—bitter, stim., useful in gonor.

D. spinosa Roxb. (Burm.-Yechinya); root—destroys effects of alcohol.

D. sympathetica Nimmo. (Bo.-Peatguli); leaves—alter.

D. volubilis Roxb. (H.-Bhatia, Bo.-Alai, M.-Bandigarjana); used as gargle, root-juice—in gonor.

Daphne oleoides Schreib.; Thymelæaceæ; (P.-Mashur, Bo.-Pech); poisonous.

Datisca cannabina Linn.; Datiscaceæ; (H. & Bo.-Akalber.); bitter, purg. febge.; glucd. datiscin; Compt. Rend., 1925, 1419; Arch. Pharm., 1918, 51; Ann. Chem., 1893, 261; 1894, 346.

Datura alba Nees.; Solanaceæ; (S.-Umatta vrikshaha, H.-Sadah-dhatura, B.-Dhutura, Bo.-Dhotari, M.-Umattai); intoxicant, digest., antisp.; alk. atropine, hyoscyamine, hyoscine; Ann. Chem., 1898, 149; Arch. Pharm., 1906, 68; 1926, 140; Apoth. Ztg., 1905, 669.†

D. fastuosa Linn. (S.-Krishna dhatura, H. & B.-Kala dhatura, M.-Karu umattai); in snake-bite; constituents similar to D. ALBA.†

D. metel Linn.; use same as other species; alks.—hyoscyamine, hyoscine, atropine; Arch. Pharm., 1905, 303, 309, 220; 1910, 641; Pharm. Monatsh., 1923, 63.†

D. stramonium Linn. (B.-Sada dhutura, P.-Tattu dattura, M.-Umatai); atropine, hyoscine, hyoscyamine; Arch. Pharm., 1905, 306, 328; Ber., 1880, 909; Proc. Roy. Soc., 1891, 391.*

Daucus carota Linn.; Umbelliferæ; (S.-Shikha-mulam, H., B. & P.- Gajar, M.-Gajjara kelangu); seeds—arom., stim., carmin., used in kidney disease and dropsy; As—0,005 mg. in 100 g. root; Compt. Rend. 1912, 893 (C. C. 1912, I. 1730).

Davallia tenuifolia Wall.; Chinese Mat. Med.

Delphinium ajacis Royle.; Rnaunculaceæ; alk.; Arch. Pharm. 1913, 207 O'Shaughnessy, Beng. Disp.

D. brunonianum Royle. (P.-Laskar); scent like musk, destroys ticks in animals.

D. cœruleum Jacq. (P.-Dhakangu); root—kills maggots in wounds of goats.

D. denudatum Wall. (H.-Nirbisi); root—in toothache, adulterant for aconite.

D. elatum Linn.; alk. 1%; Arch. Pharm., 1925, 274.
Var. incisum and ranunculifolium.

D. paciflorum Royle.; Birdwood, Veg. Prod. Bombay.

D. speciosum Janka.; used to destroy ticks in animals.

D. zalil Aitch. et Hemsl. (H.-Asbarg, Bo.-Gul-jalil); anodyne, diur., used in jaundice and dropsy; alk., glucd.; Pharm. Ind., Vol. III, 27; Proc. Chem. Soc., 1897-98, 55; J. C. S., 1898, 267.†

Dendrobium crumenatum Sw.; Orchideæ; alk.

D. macræi Lindl.; (S., H., B. & Bo.-Jivanti); demulc., tonic, used in snake-bite; alk.; Bull. Inst. Buitenzorg., 1902, 36.

Dendrocalamus strictus Nees.; Gramineæ; (H.-Bans kaban, B.-Karail, Bo.-Bas, M.-Kanka); silicious matter—tonic, astrin., leaves—ecbolics to animals.

Derris elliptica Benth.; Leguminosæ; (Malay.-Tubah); fish poison, larvicide; glucd.—derrid, anhydro derrid, tubo toxin, derrin; Arch. Pharm., 1911, 298; Jr. Soc. Chem. Ind., 1927, T 365; Chem. Drug., 1921, 41; Ber., 1928, 1003.

D. scandens Benth. (B.-Noalata, P.-Gunj, M.-Nala tige); bark—cholag., fish poison, used in snake-bite.

D. uliginosa Benth. (B.-Pánlata, Bo.-Kirtana); bark—fish poison, useful in rheum. and dysmen.; alk., glucd.; Arch. Pharm., 1902, 145; 1903, 1.†

Desmodium gangeticum DC.; Leguminosæ; (S. & Bo.-Shalparni, H.-Sarivan, B.-Sálpáni, M.-Gitanaram); in fever, cough, vomiting, asthma, snake-bite and scorpion-sting; alk.

D. latifolium D.C.; (M.-Chithamalli); roots—alter., tonic, given in fever, diar., vomiting, bowel complants, insanity and ulcers.

D. polycarpum DC. (Santh.-Bœphol); used in fainting and convulsion.

D. pulchellum Benth. (S.-Lodrom, M.-Vellalothi); decoct. of the bark —used in hæmor., diar., poisoning and eye diseases, flowers—used in biliousness.

D. tiliæfolium G. Don. (H.-Sambar); roots—carmin., tonic, diar.

D. triflorum DC. (B.-Kodalia, H.-Kudaliya, Bo.-Jangli methi, M.-Munta mandu); galact., remedy for diar. and convulsion.

Dianthus anatolicus Boiss.; Caryophylleæ; (Ind. Baz.-Kanturiyun).

Dichroa febrifuga Lour.; Saxifragaceæ; (H.-Basak, Nep.-Aseru); root—emetic, febge.; cyst. glucd., dichorin: Hartwich, Nene. Arzneidrogen., 1897, 127.

Dichrostachys cinerea W. & A.; Leguminosæ; (S.-Viravriksha, H.-Vurtuli, Bo.-Segumkati, M.-Vedatalla); young shoots useful in ophthalmia.

Dicliptera roxburghiana Nees.; Acanthaceæ; (P.-Kirch); tonic.

Dicoma tomentosa Cass.; Compositæ; (M.-Navananji-chapála); febge.

Dictamnus albus Linn.; Rutaceæ; arom. bitter, used in intermittent fever, nervous diseases and amenor.; cryst. tox. alk. dictamine, cryst. saponin dictamnolacton, essen. oil; Ber. Pharm. Ges., 1923, 68; Schim. Ber., 1924, 23; 1925, 20.

Didymocarpus aromatica Wall.; Gesneraceæ; (H.-Kumkuma); arom.

Digitalis purpurea Linn.; Scrophularineæ; imported, now being cultivated.*

Dillenia indica Linn.; Dilleniaceæ; (S.-Bhavya, H. & B.-Chálta, Bo.-Mota karmal, M.-Uva); cooling beverage in fevers.

Dionysia diapensiæfolia Boiss.; Primulaceæ; (Ind. Baz.-Hamama); sedative, used in gout and uterine obstructions; cryst. alk.

Dioscorea aculeata Linn.; Dioscoreaceæ; (S.-Madhválu, H.-Man-álu, B.-Man álu, Bo.-Kánte-kángi, M.-Kata kelenga); alk.; Bull. Sci. Pharm., 1909, 509.

D. alata Linn.; tox. alk.; Meded. Lands Plantent., 1894, 68; 1899, 123.

D. bulbifera Linn. (H.-Zamin kand, Bo.-Karinda, M.-Karu karinda); used in piles, dysen.; syphilis; poisonous glucd.; Pharm. Ztg., 1892, 776.

D. globosa Roxb. (S.-Pindalu, H. & B.-Chupri álu, Bo.-Chopri álu, M.-Gunapendálam); anthelm., useful in leprosy, piles, gonor.

D. hirsuta Dennst.; tox. alk., behaves like picro toxin; Meded. Lands Plantent. 1894, 13 and 68; 1899, 141; (C. C. 1910. II. 1228); Ann, Jard. Bot. Buitenzorg., 1909. II. Suppl. 3, 385.

D. oppositifolia Linn. (S.-Sarpakhya, Bo.-Márapasapoli, M.-Avatenga tige); root—used to reduce swelling, in scorpion-sting and snake-bite; Bull. Sc. Pharm., 1909, 509.

D. pentaphylla Linn. (H. & Bo.-Kanta álu, M.-Kattu valli kalangu); tonic, tubers—used for swellings; Meded. Lands Plantent, 1894, 16; 1899, 141.

Dioscorea purpurea Roxb. (S.-Raktalu, H. & B.-Lal-gurania álu, Bo.-Ratalu); bitter, nutri., useful in bilious affections; Bull. Sci. Pharm., 1909, 509.

D. sativa Linn (H.-Ratalu, Bo.-Chiná, M.-Goradu); applied externally.

D. triphylla Linn. (Bo.-Mándá, M.-Ts-iagri-nuren); internally—irrit.

Diospyros candolleana Wight.; Ebenaceæ; (S.-Nila-vriksha, M.-Karimaram); decoct. of the bark—used in rheum. and swellings.

D. ebenum Kœnig.; (H. & Bo.-Tendu, M.-Acha); astrin.; Arch. Pharm., 1899, 369.

D. embryopteris Pers. (S.-Tinduka, H. & B.-Gab, Bo.-Tendu, M.-Tumika); astrin., in diar. and snake-bite.

D. melanoxylon Roxb. (S.-Kenduka, H.-Kendu, B.-Kend, Bo.-Temru, M.-Tumbi); bark—in diar., dyspep., tonic.

D. montana Roxb. (S.-Tumala, H.-Lohari, B.-Ban-gál, Bo.-Kundu, M.-Muchi-tanki; fruit—poisonous.

D. paniculata Dalz. (S.-Thinduka, M.-Karinthuvari); leaves—fish poison, decoct. of the fruit—given in gonor., to purify blood and biliousness, powdered bark—in rheum. and ulcers.

D. tomentose Roxb. (S.-Kakinduka, H.-Tumal, B.-Kend, M.-Chilta tumiki); alter.

Diplospora sphærocarpa Hook.; Rubiaceæ; roasted seeds—taste and smell like coffee, alk. like caffine.

Dipterocarpus alatus Roxb.; Dipterocarpeæ; (B.-Garjan); balsam—subst. for copaiba, remedy for leprosy; essen. oil, resin containing cryst. acid; Arch. Pharm., 1903, 372; 1908, 71; Ann. Chem., 1909, 56; 1910, 105; Schim. Ber., 1913, April, 61; 1915, April, 30.†

D. incanus Roxb. (B.-Garjan); see D. ALATUS.

D. indicus Bedd.; (M.-Ennei); resin—used in rheum.

D. tuberculatus Roxb. (Burm.-Eng); oleoresin—applied to ulcers; essen. oil; Schim. Ber., 1913, April, 61.

D. turbinatus Gærtn.; (B.-Tilya garjan, Bo.-Gurjun, M.-Challani); Arch. Pharm., 1903, 372; Schim. Ber., 1913, April, 61.

Dodonæa viscosa Linn.; Sapindaceæ; (H.-Aliar, Bo.-Bandurgi, M.-Virali); febge., sudorific, in gout and rheum.; saponin; Apoth Ztg., 1893, 589; Pharm. Jr., 1909, 795.

Dolichandrone falcata Seem.; Bignoniaceæ; (H.-Háwar, Bo.-Manchingi, M.-Kadatathie); abortif., fish poison; Meded. Lands Plantent, 1897, 39; 1899, 136.

D. rheedii Seem. (M.-Vilpadri); seeds—antisp.; Meded. Lands Plantent, 1897, 39; 1899, 136.

D. stipulata Benth.; (Burm.-Petthan); alk.; Meded. Lands Plantent. 1897, 39; 1899, 136.

Dolichos biflorus Linn.; Leguminosæ; (S.-Kulattha, H. & Bo.-Koolthee, B.-Kurti-kalai, M.-Kollu); astrin., diur., tonic, used in leucor. and menstrual disorders; enzyme-urease; Biochem. Jr., 1914, 449; Jr. Biol. Chem., 1916, 297.†

D. falcatus Klein.; (M.-Kattamara); root—used in piles, constip., ophthalmia and skin diseases, decoct. of the seeds specific for rheum.

D. lablab Linn. (S.-Shimbi, H.-Sim, B.-Makham Sim, Bo.-Panti, M.-Avarai); root—poisonous; Arch. Pharm., 1906, 668.

Dolomæa macrocephala DC.; Compositæ; root—in eruptions; Stewart, Punj. Plants.

Dorema ammoniacum Don.; Umbelliferæ; (Ind. Baz.-Ushak); used in enlargement of liver and spleen; essen. oil; Schim. Ber., 1890, April, 47; 1915, April, 7; Ber., 1917, 1823; Arch. Pharm., 1895, 553.†

D. aureum Stocks; resembles D. AMMONIACUM.

Doronicum hookeri Clarke.; Compositæ; (P.-Darunaj-akrabi); root—arom., tonic.
D. pardalianches Linn. (Ind. Baz.-Darunaj-i-akrabi); cardiac tonic., useful in nervous depression, melancholia, in scorpion-bite.
D. roylei DC. (P.-Darunaj-akhrabi); similar to D. HOOKERI.
Dracæna cinnabari Balf.; Liliaceæ; (H.-Hiradukhi, M.-Kandamurgarittam); stops hæmor., astrin.; benzioc acid, cinnamic acid; Pharm. Jr., 1883, 361.
Dracocephalum moldavicum Linn.; Labiatæ; (H.-Tukhmferungmishk); seeds—demulc.; essen. oil; Schim. Ber., 1930, 21; Trans. Chem. Pharm. Inst. Moscow., 1930, 5.†
D. royleanum Royle; O'Shaughnessy, Beng. Disp.
Dracontium polyphyllum Linn.; Aroideæ; (Bo.-Sevala); emmen., used in hæmorhoids., asthma.
Dregea volubilis Benth.; Asclepiadeæ; (S.-Madhu malati, H.-Nakchikni, B.-Titakunga, Bo.-Dodhi, M.-Kodicpalay); expect., used in eye diseases and snake-bite; glucd. dregein, alk.; Bull. Pharm., 1891, 211; Pharm. Jr., 1891, 617.†
Drepanocarpus spinosus Kurz.; see DALBERGIA SPINOSA.
Drosera peltata Sm.; Droseraceæ; (H.-Mukajali, P.-Chitra); bitter, acid, caustic, used in phthisis; enzymes; Proc. Roy. Soc. Lond., 1910, 134.
Drynaria quercifolia Linn. (Bo.-Basingh); in phthisis, fever, dyspep.
Dryobalanops aromatica Gærtn.; Dipterocarpeæ; diaphor., antisep., antisp., stim., in hysteria and dysmen.; borneol, camphene, terpeniol, sesquiterpene, etc.; Schim. Ber., 1910, Oct., 139; 1913, April, 31.†
D. camphora Coleb. see D. AROMATICA.
Dysoxylum malabaricum Bedd.; Meliaceæ; (S.-Agaru, M.-Kana-mulla); decoct. of the wood—used in rheum., oil—used in ear and eye diseases.

Ecballium elaterium A. Rich.; Cucurbitaceæ; (Ind. Baz.-Katri-indrayan); narcotic, used in malaria and hydrophobia, glucd., elaterin, ecballin, prophetin; Compt. Rend., 1906, 1161; 1909, 566; Ber., 1906, 3380; J. C. S., 1909, 1985; Pharm. Jr., 1909, 501.†
E. linneanum Kurz. (H.-Udajati); roots—in jaundice and menor.
Echinops echinatus DC.; Compositæ; (S.-Utakantaka, H.-Utakatara); alter., diur., nerve tonic, used in hoarse cough, hysteria, dyspep., scrofula.
Echites dichotoma Roxb.; Apocynaceæ; (S.-Bhadravalli, B.-Haparmali, M.-Arbimallika); useful in leprosy.
Eclipta alba Hassk.; Compositæ; (S.-Kesharája, H.-Bhangra, B.-Kesuria, Bo.-Máká, M.-Kaikeshi): tonic, in scorpion-sting; alk. ecliptine; Pharm. Ind., Vol. II, 268.†
E. prostrata Roxb.; emetic, in enlarged liver and spleen and dropsy; Prain, Beng. Plants.
Ehretia buxifolia Roxb.; Boragineæ; (H. & Bo.-Pála, M.-Kuruvingi); alter., used in debility and syphilis; glucd.; Ber. Pharm. Ges., 1899, 214.†
E. obtusifolia Hochst. (P.-Chamror); root—in venereal diseases.
Elæagnus hortensis M. Bieb.; Elæagneæ; (Tibet.-Sirshing, H.-Shiulik).
E. latifolia Linn. (B.-Guara, Bo.-Ambgul, H.-Ghiwain); flowers—cardiac, astrin.
E. umbellata Thunb. (P.-Ghiwain); flowers—stim., cardiac, astrin.

Elæocarpus ganitrus Roxb.; Tiliaceæ; (S.-Rudráksha, H.-Rudrák, B.-Rudrákya, Bo.-Rudraksh, M.-Rudra-kai); stim.
E. oblongus Gærtn. (M.-Malankara); fruit—used as emetic, also in rheum., pneumonia, ulcers, leprosy, dropsy, piles.
E. serratus Linn.; (B.-Julpai, M.-Olang-karai); leaves—used in rheum., antid. to poison, fruits—used in dysen., diar.
E. tuberculatus Roxb. (S.-Rudraksha, M.-Rutthraksham); decoct. of the bark—used in hæmetemesis, biliousness; nuts—used as remedy for rheum., typhoid fever, epilepsy.
Elæodendron glaucum Pers.; Celastrineæ; (H.-Bakra, Bo.-Bhutá-palá, M.-Selupa); astrin., in snake-bite.
Elephantopus scaber Linn.; Compositæ; (S.-Gojihbá, H.-Gobhi, B.-Gojialata, Bo.-Hastipata, M.-Anashovadi); cardiac tonic, alter., febge., in snake-bite.
Elettaria cardamomum Maton.; Scitamineæ; (S.-Ela, H. & B.-Choti-elachi, Bo.-Elachi, M.-Ellakai); stomch., diur., in scorpion-sting.; essen. oil; Schim. Ber., 1897, Oct. 9; 1910, Oct. 30; Ann. Chem., 1908, 90; Pharm. Jr., 1899, 105; Amer. Jr. Pharm., 1910, 167.*
Eleusine ægyptiaca Desf.; Gramineæ; (H.-Makra, Bo.-Mhar, M.-Tamida); seeds—in pain in kidney region.
Embelia ribes Burm.; Myrsineæ; (S.-Vidanga, H.-Baberáng, B.-Biranga, Bo.-Vavadinga, M.-Vellal); in scorpion-sting and snake-bite; embelic acid; Arch. Pharm., 1900, 15; Apoth. Ztg., 1913, 699.
E. robusta Roxb. (H.-Bayabirang, Bo.-Barbatti); antisp., carmin., anthelm.
Emilia sonchifolia DC.; Compositæ; (H.-Kirankhuri, B.-Sudhimudi, Bo.-Sadamandi); sudorific, similar to taraxacus.
Enhydra fluctuans Lour.; Compositæ; (S.-Hilamochiká, H.-Harkuch, B.-Hinghchá); laxt., useful in skin and nervous affections.
Enicostema littorale Blume.; Gentianaceæ; (H.-Chota-kiráyat, Bo.-Kada-vinayi, M.-Vallari); stomch., tonic, laxt.; bitter principle; Arch. Pharm., 1869, 229; Pharm. Jr., 1874, 481.
Entada scandens Benth.; Leguminosæ; (H.-Chian, B.-Gilagach, Bo.-Gardal); seeds—emetic, fish poison; saponin, glucd., alk.; Bull. Inst. Bot. Buitenzorg., 1902, 20; Jr. Pharm. Chim., 1909, 162; Arch. Pharm., 1903, 614.†
Ephedra distachya Linn.; Gnetaceæ.*
E. foliata Boiss.; var. ciliata Fish. & May.*
E. gerardiana Wall.; var. saxatilis, sikkimensis and wallichii; alks.; Jr. Amer. Pharm. Assoc., 1928, 1189; Chin. Jr. Physiol., I, 397.*
E. intermedia Schrenk & Mey., syn. E. PACHYCLADA Boiss. var. glauca and tibetica.*
E. nebrodensis Tines., var. procera.*
E. pedancularis Boiss.*
E. vulgaris Rich. (P.-Amsania, Butshur); cordiac and circulatory stim., diur., in urticaria, angio-neurotic œdema, in asthma.*
Equisetum debile Roxb.; Equisetaceæ; (P.-Matti, Santh.-Buru-katkon-charec.); cooling in gonor.
Eragrostis cynosuroides Beauv.; Gramineæ; (S. & B.-Kusha, H.-Durva, Bo.-Darbh); diur., in dysen., menor.
Eremostachys vicaryi Benth.; Labiatæ; (P.-Gurgunna); seeds—cooling, fish poison.
Erigeron asteroides Roxb.; Compositæ; (Bo.-Maredi); stim., diur.
E. canadensis Linn.; used in diar., dysen. and uterine hæmor.; oil—in bronchial catarrh., cystitis; essen. oil; Pharm. Rev., 1905, 81; 1906, 326; Schim. Ber., 1894, Oct. 73; 1922, 20.†
About five species of Erigeron are uninvestigated.

Eriobotrya japonica Lindl.; Rosaceæ; (M.-Lakota); useful in indign.; Bull. Chim. Pharm., 1910, 713; Arch. Pharm., 1907, 469; Bull. Soc. Chim., 1898, 310.

Eriodendron anfractuosum DC.; Malvaceæ; (S.-Sveta shalmali, H.-Safed simool, B.-Sveta shimool, Bo.-Safed savara, M.-Biliburga); gum—tonic, alter., astrin., laxt., roots—emetic, in scorpion-sting, unripe *fruit*—demulc.; Arch. Pharm., 1913, 438; Amer. Jr. Pharm., 1922, 34.

Eriolæna quinquelocularis Wight.; Sterculiaceæ; (Bo.-Budjari-dha-mun); poultice of root used in wounds.

Eruca sativa Lam.; Cruciferæ; (S.-Siddartha, H.-Taramira, B.-Shwet-sursha); seeds—acrid and used like mustard; essen. oil; Pharm. Ztg., 1912, 520; Schim. Ber., 1912, Oct. 105.

Ervum lens Linn.; Leguminosæ; (S.-Masura, H.-Masur, B.-Masuri, Bo.-Masuri-dal, M.-Misurpurpur); *in snake-bite*; As—0,01 mg. in *100* g. seeds; Compt. Rend. 1912, 893 (C. C. 1912. I. 1730).

Erycibe paniculata Roxb.; Convolvulaceæ; (Santh.-Kari); bark—in cholera.

Eryngium cæruleum Bieb.; Umbelliferæ; (H.-Dudhali); root—nerve tonic, aphrodis.

Erythræa roxburghii G. Don.; Gentianaceæ; (H.-Charayatah, B.-Girmi, Bo.-Luntak); subts. for chiretta.

Erythrina corallodendron Linn.; Leguminosæ; narcotic alk. erythrine; Dragendorff, Heilpflanzen, 333.

E. indica Lam.; (S.-Palit-mandár, H.-Pangra, B.-Palitá-mádár, Bo.-Pangaru, M.-Bádisc); febge., in liver troubles, ophthalmia, antid. to snake-bite, juice—vermifuge, cath.; poisonous alk.; Ber., 1890, 3537; Apoth. Ztg., 1894, 11; Ber. Pharm. Ges., 1899, 214.

E. stricta Roxb.; (S.-Mura, M.-Murukku); powder of the bark—is used in biliousness, rheum., itch, burning sensation, fever, fainting, asthma, leprosy, epilepsy; flowers—antid. to poison.

Erythroxylon coca Lam.; Lineæ: local anæsthetic; cocaine; Pharm. Jr., 1901, Jan. 5, 4; Jan. 26, 81; Chem. Weekbl., 1908, 666; Arch. Pharm., 1910, 303; Bull. Imp. Inst., 1912, 37.*

E. lucidum Moon.; alk.; Pharm. Jr., 1889, 569.

Four species of Erythroxylon are uninvestigated.

E. monogynum Roxb. (M.-Devadárum); tonic; essen. oil; Schim. Ber., 1924, 23; cocaine; Ann. Jard. Bot. Buitenzorg., 1888, 225; Jr. Ind. Inst. Sci., 1926, 145; Jr. Mys. For. Assoc., 1923, 4.

E. retusum Bauer; alk.; Ann. Jard. Bot. Buitenzorg, 1888, 225.

Eucalyptus globulus Labill.; Myrtaceæ; (M.-Karpura maram); carmin., stim., antisep.*

Euchretia buxifolia Roxb. (H.-Pala); roots—alter.

Eugenia caryophyllifolia Lam.; Myrtaceæ; Prain, Beng. Plants.

E. hemisperica Wight.; Myrtaceæ; (M.-Velleinyarel); decoct. of the bark—used in biliousness and syphilis.

E. jambolana Lam. (S. & Bo.-Jambu, H. & B.-Jam, M.-Nairuri); in diabetes; glucd., essen. oil; Pharm. Jr. 1912, 414; Jr. Amer. C. S. 1916, 2805.

E. jambos Linn. (S.-Jambu, H. & B.-Golabjam, Bo.-Jamu, M.-Pannerali); leaves—useful in sore eyes; alk. jambosine; Pharm. Jr., 1884, 717; essen. oil; Amer. Jr. Pharm., 1894, 209.†

E. operculata Roxb. (H.-Rai-jáman); fruit—used in rheum.

Eulophia campestris Wall.; Orchideæ; (B.-Sung-misrie, P.-Salib misri, Bo.-Sálum); tonic, aphrodis.

E. nuda Lindl. (S.-Manya, H.-Goruma, B.-Budbar, Bo.-Mánkand); anthelm., used in scrofulous affections.

Eulophia virens Br.
Euonymus crenulatus Wall.; Celastrineæ.*
E. pendulus Wall. (H.-Chopra).*
E. tingens Wall. (H.-Kungku); purg.*
About twenty species of Euonymus are uninvestigated.
Eupatorium ayapana Vent.; Compositæ; (H. & B.-Ayapana); stim., tonic, diaphor., used in ulcers and sores; essen. oil; Schim. Ber., 1907, April, 14; 1908, April, 14; Chem. Ztg., 1886, 433.
E. cannabinum Linn.; diaphor., diur., emetic, used in jaundice, scurvy, ulcers; alk.; Jr. de Pharm., 1828, 623.
Euphorbia antiquorum *Linn.*; Euphorbiaceæ; (S.-Vajrakantaka, H.-Tridhára-sehund, B.-Tekáta sij, Bo.-Naraseja, M.-Shadhurak-kalli); purg., stomch., used in enlargements of spleen, in jaundice, leprosy and in snake-bite; euphorbin; Arch. de Pharm., 1886, 729.
E. dracunculoides Lam. (B.-Chhagul-puputi, P.-Kangi, M.-Tillá-káda); officinal.
E. helioscopia Linn. (H.-Hirruseeah, P.-Ganda bute); anthelm., cath.; saponin phasin; Biochem. Ztscher., 1919, 24; Bull. Sc. Pharm. 1926, 193.
E. hypericifolia Linn. (Bo.-Naveti, P.-Hazárdána); leaves—in dysen., diar. and leucor., alk., glucd.; Pharm. Jr., 1923, 162.
E. lathyris Linn. (B.-Burg-sadab, P.-Sudab); leaves—carmin., seeds—used in dropsy; capsules—intoxicate fish; euphorbon, enzymes, æsculetin; Ber., 1890, 3347; Chem. Weekbl., 1916, 1282; Arch. Pharm., 1924, 449.
E. microphylla Heyne. (B.-Chota keruee, Santh.-Dudhiaphul); galact.
E. neriifolia Linn. (S.-Snuhi, H.-Sehund, B.-Mansa-sij, Bo.-Minguta, M.-Ilaikalli); root—in scorpion-sting and snake-bite, antisp.
E. nivulia Ham. (S.-Patta karie, B.-Sij, Bo.-Newrang, M.-Aku-jemudu); milk similar to E. NERIIFOLIA.
E. pilulifera Linn. (H.-Dudhi, B.-Bara keru, Bo.-Nayeti, M.-Amumpatchai arissi); anthelm., used in spasmodic dyspnœa; alk., essen. oil; Pharm. Jr., 1909, 141; 1913, 506; 1923, 162.*
E. resinifera Berg. (Ind., Baz.-Farfiyum); purg., abortif., used in sciatica; euphorbon, euphorbol, euphorbia resin; Arch. Pharm., 1905, 249; 1907, 690; 1928, 633; Jr. Prakt. Chem., 1929, 97.
E. royleana Boiss. (H. & P.-Shakar pitan); anthelm., cath.
E. thomsoniana Boiss. (Kash.-Hirtiz); purg., detergent for washing hair.
E. thymifolia Burm. (S.-Racta-vinda-chada, H.-Chhoti dudhi, B.-Dudiya, Bo.-Nayeti, M.-Sittrapaladi); arom., astrin., used in snake-bite and skin diseases.
E. tirucalli Linn. (H.-Sehud, B.-Lankasij, Bo.-Shera, M.-Kombu-Kalli); purg., counter-irrit., fish poison; euphorbon; Arch. Pharm., 1886, 729; Ann. Chim. Appl., 1928, 540.
Euphrasia odontites Linn.; Crophularineæ; glucd. rhinanthin (aucubin); Arch. Pharm., 1880, 289.
E. officinalis Linn.; glucd. rhinanthin (aucubin); Bull. Soc. Chim. Biol., 1924, 665.
Euryale ferox Salisb.; Nymphæaceæ; (S., H. & B.-Makhana, M.-Mallani-padman); useful in spermatorrhœa, tonic.
Eurycoma longifolia Jack.; Simarubeæ; (Malay.-Penvar-pet); bark and root—febge.; bitter fatty oil; Pharm. Weekbl., 1912, 1050.
Evodia meliæfolia Benth.; Rutaceæ; alk. berberine; Chem. News, 1895, 207; Arch. Pharm., 1878, 337; Henry, Plant Alkaloid.
E. roxburghiana Benth.; (S.-Vanashempaga, M.-Kanalei); root-bark—boiled in oil given to improve complexion, juice of leaves—in fever.

Evodia rutæcarpa Hk. f. & T.; alks. evodiamine, rutaecarpine; C. C. 1923. III. 248; Jr. Pharm. Chim. 1916, 54; Jr. Pharm. Soc. Japan, 1916, 416.

About six species of Evodia are uninvestigated.

Evolvulus alsinoides Linn.; Convolvulaceæ; (S.-Vishnugandhi, H.-Sankha pushpi, Bo.-Shankha valli, M.-Visnu-karandi); anthelm., febge., tonic; alk.

Exacum bicolor Roxb.; Gentianaceæ; (H.-Bará-charáyata); tonic, stomch., subst. for Gentian.

E. **pedunculatum** Linn. subst., for Gentian.

E. **tetragonum** Roxb. (H.-Ava-chiretta, B.-Koochuri); tonic, stomch.

Exacum lawii Clarke; Gentianaceæ; (M.-Marukozhunthu); juice of the whole plant—boiled with oil applied in eye-diseases; powdered plant —used in kidney disorders and antid. to poisons.

Excæcaria acerifolia Didrichs.; Euphorbiaceæ; (H.-Básingh); used in rheum.

E. **agallocha** Linn. (B.-Gangwa, Bo.-Geva, M.-Chilla); purg., alter., tonic, remedy for snake poison; Bull. Dept. Agri. Indes. Neerl., 1907, 22.

Fagonia arabica Linn.; Zygophylleæ; (S.-Dusparsha, H.-Ustarkhár, Bo.-Dhamasa); antisep., used in stomatitis.

F. **bruguieri** DC. (H.-Damáhán, Bo.-Dhamaso); febge., tonic.

F. **cretica** Linn.; prophylactic against smallpox.

Fagræa fragrans Roxb.; Loganiaceæ; (Burm.-Anan); bark—febge.; alk. and bitter substance.

F. **imperialis** Miq.; alk.; Meded. lands Plantent, 1896, 17; 1899, 134.

F. **racemosa** Jack. (Burm.-Thithpaloo); root bark—used in fever.

Farsetia ægyptiaca Turr.; Cruciferæ; (P.-Farid-buti); used in rheum.

F. **hamiltonii** Royle. (P.-Farid-buti); used in rheum.

F. **jacquemontii** Hk. f. & T. (P.-Mulei); in rheum.

Feronia elephantum Correa.; Rutaceæ; (S.-Kapittha, H.-Kavitha, B.-Kathbel, Bo.-Kavit, M.-Nilavilam); fruit—astrin., leaves—arom., carmin., pulp—remedy for bites of venomous insects and reptile; Jr. de. Pharm. 1905, 289.†

Ferula alliacea Boiss.; Umbelliferæ; (S.-Hingu, H. & B.-Hing, M.-Kayam); in scorpion-sting, intestinal antisep., carmin., in hysteria and epilepsy; essen. oil; Pharm. Jr. 1875, 401; Arch. Pharm. 1878, 309.

F. **fœtida** Regel. (S.-Hingu, H. & B.-Hing, Bo.-Hingra, M.-Káyam); use same as F. ALLIACEA; essen. oil, ferulic acid, organic sulphur comp.; Ann. Chem. 1849, 23; 1866, 64; Chem. Drug. 1910, 205; Arch. Pharm. 1891, 1; Schim, Ber. 1912, April, 25.* †

F. **galbaniflua** Boiss et Bushe. (Ind. Baz.-Jawashir, H.-Ganda-biroza); expect., antisp., stim., used in chr. broncht. and asthma, uterine tonic; essen. oil; Pharm. Jr., 1915, 356; Modern Perfume 1921, 82; Schim. Ber., 1929, 44.†

F. **jæschkeana** Vatke.; gum-resin applied to wounds and bruises.

F. **narthex** Boiss. (S.-Bhutnasan, H., B. & Bo.-Hing); use same as F. GALBANIFLUA Boiss.

F. **sumbul** Hook.; use same as F. NARTHEX.; essen. oil umbelliferon; Arch. Pharm. 1859, 1; 1899, 256; Schim. Ber. 1907, Oct. 63, Jr. Amer. C. S. 1916, 432.

Fibraurea tinctoria Lour.; Menispermaceæ; alk. berberine; Bull. Inst. Bot. Buitenzorg., 1902, 11; Arch. Pharm., 1906, 120.

Ficus arnottiana Miq.; Urticaceæ; (S.-Plaksha, M.-Aswathom); used in skin diseases.

Ficus asperrima Roxb.; (H.-Kalmnor, Bo.-Kharoti, M.-Karakar-bunda); in enlargement of liver and spleen; alk. Pharm. Ind., Vol. III, 346.

F. bengalensis Linn. (S.-Vata, H.-Bor., Bo.-Vad, M.-Vada); milky juice applied externally in rheum. and lumbago; bark—astrin., used in dysen., diar., diabetes.

F. benjamina Linn. (Bo.-Pimpri, M.-Putra-juvi); leaves—applied to ulcers.

F. carica Linn. (S.-Anjira, H. & B.-Anjir, Bo.-Anjra, M.-Anjura); aper., emol., used internally in snake-bite; proteose, amino acid, tyrosin; Bull. Acad. Rommaine, 1916, 346; enzyme cravin; Arch. Pharm., 1881, 226; lipase, protease; Compt. Rend., 1912, 56.

F. cunia Ham. (H.-Khewnau, B.-Jagya-domur, M.-Poroh); in leprosy, bladder complaints.

F. dalhousiæ Miq.; (S.-Somavalkhom, M.-Kallal); fruit—used in heart disease, leaves and bark—in liver complaints and skin diseases.

F. gibbosa Blume. (S.-Udumber, Bo.-Datir, M.-Tella-varinka); root bark —stomch., aper.; alk.

F. glomerata Roxb.; (S.-Udumbara, H.-Gular, B.-Jagya-domur, Bo.-Umbar, M.-Atti); use similar to F. BENGALENSIS.

F. heterophylla Linn. (S.-Tráyamáná, B.-Bhui-dumur, M.-Buroni); root —used in colic, leaves—in dysen., bark—in cough and asthma.

F. hispida Linn. (S.-Kákadumbura, H.-Konea-dumbar, B.-Kakdumur, Bo.-Rambal, M.-Pe-attiss); purg., emetic; saponin; Pharm. Ind., Vol. III, 347.

F. infectoria Roxb. (S.-Plaksha, H.-Pilkhan, B.-Pakar, Bo.-Pipli, M.-Pepre); bark—in ulcers, leucor.

F. oppositifolia Willd.; milky juice used in medicine.

F. palmata Forsk. (H.-Anjiri, P.-Janir, Bo.-Pepri); fruit—demulc., laxt., used in diseases of the lungs and bladder.

F. religiosa Linn. (S. & B.-Asvatha, H.-Pipal, Bo.-Pimpal, M.-Arasa); use similar to F. BENGALENSIS.

F. retusa Linn. (B.-Kamrup, M.-Yerrajuvi); bark—in liver disease.

F. ribes Reinw.; (H.-Chhota jangli anjur); use similar to F. HISPIDA.

F. rumphii Blume. (H.-Pakar, B.-Gaiaswát, Bo.-Pair); emetic., in asthma and snake-bite.

F. talboti King. (S.-Plaksha, M.-Kal-itthii); decoct. of the bark—used in ulcers, venereal diseases, diar. and leprosy.

F. tsiela Roxb. (S.-Kancenika, H.-Jari, Bo.-Pimpri, M.-Ichchi); used in colic.

Fimbristylis junciformis Kunth.; Cyperaceæ; used in dysen.

Flacourtia cataphracta Roxb.; Bixineæ; (S.-Talisha, H. & M.-Talispatri, B.-Paniyálá, Bo.-Jaggam); in liver complaints.

F. ramontchi L'Herit. (H.-Bilangura, B.-Bincha, Bo.-Swadu, M.-Kaka); used in jaundice and enlarged spleen.

F. sapida Wall.; used in liver complaints; Birdwood, Veg. Prod. Bombay.

F. sepiaria Roxb. (H.-Kondai, Bo.-Atruna, M.-Kanru); infusion of leaves —in snake-bite.

Flemingia congesta Roxb.; Leguminosæ; (H.- & B.-Bara-salpan, Bo.-Dowdowla); external application to ulcers and swellings; J. C. S. 1898, 660; Pharm. Jr. 1890, 213.

F. grahamiana W. & A.; used in skin diseases.

F. nana Roxb. (H. & B.-Bara-salpan); roots—in ulcers and swellings.

F. strobilifera R. Br. (H.-Kusrunt, Bo.-Bundar); root—in epilepsy, hysteria.

F. tuberosa Dalz. (Bo.-Birmova); in dysen. and leucor.

Flueggea leucopyrus Wight.; Euphorbiaceæ; fish poison; alk.
F. microcarpa Blume. (H.-Dalme, Bo.-Pandharphali); anthelm., fish poison; alk.; Pharm. Ind., Vol. III, 270.
Fœniculum vulgare Gærtn.; Umbelliferæ; (S.-Madhurika, H.-Bari-saunf, B.-Pan-mauri, Bo.-Bari sopha, M.-Shombu); stim., arom., carmin., diur., emmen., purg.; essen. oil; Jr. Ind. Inst. Sci., 1925, 184; Bull. Imp. Inst. Lond. 1927, 107; Ber. Pharm. Ges. 1913, 570.*
Francœria crispa Cass.; Compositæ; used as a vulnerary in bruises.
Frankenia pulverulenta Linn.; Frankeniaceæ; demulc., arom.
Fraxinus excelsior Linn.; Oleaceæ; (P.-Kum); bark—bitter, astrin., leaves—purg.; glucd. fraxin, essen. oil; J. C. S. 1858, 17; 1859, 126; Ber. 1929, 120, Chem. Ztg. 1911, 478.
F. floribunda Wall. (H.-Angan); exudation—subst. for manna.
F. ornus Linn. (H.-Shirkhist, M.-Ménà).
Fritillaria imperialis Linn.; Liliaceæ; heart poison; in fresh plant—tox. alk. imperialine; Ber., 1888, 3284.
About five species are uninvestigated.
Fucus distichus Linn.; Algæ; used in rheum., goitre.
F. nodosus Linn.; used in scrofula, goitre.
F. vesiculosus Linn.; use same as F. DISTICHUS.
Fumaria officinalis Linn.; Fumariaceæ; (H.-Pit-pápará, M.-Turu); laxt., diur.; alk. fumarine; Amer. Chem. Jr., 1900, 249; Arch. Pham., 1901, 401, Pharm. Ztg. 1887, 542.†
F. parviflora Lamk. (H.-Pitpapada, B.-Bansulpha, Bo.-Pit-pára, M.-Turá); use same as F. OFFICINALIS.

Galega purpurea Linn.; Leguminosæ; (S.-Sarapunkha, B.-Bannil gach, P.-Bansa); diur., tonic, laxt., useful in cough and asthma, root—in boils and carbuncles.
Galium aparine Linn.; Rubiaceæ; glucd. asperulosid; Bull. Soc. Chim. Biol., 1926, 489; Compt. Rend., 1926, 865.
G. mollugo Linn.; oxalic acid; Park. Pharm., 1856, 187.
G. verum Linn.; glucd. asperuilosid; Compt. Rend., 1927, 1674.
Garcinia cambogia Desr.; Guttiferæ; (Bo.-Vilati-amli, M.-Aradal).
G. heterandra Wall. (Burm.-Tha-nat-dau); gum resin used medicinally.
G. indica Chois.; (H. & Bo.-Kokam, M.-Murgal mara.); fruit—antiscor., cooling, cholag., emol., demulc., oil—soothing, used in skin diseases; Pharm. Jr. 1851, 65; Jr. Soc. Chem. Ind., 1898, 991.
G. mangostana Linn. (H., B. & Bo.-Mangustan); useful in chr. diar., dysen.; bitter substance mangostin; Arch. Pharm., 1891, 426; Chem. Ztg. 1897, 719.
G. morella Desr. (S., H. & B.-Tamal, Bo.-Kokum, M.-Korakpuli); gum resin—purg.; Arch. Pharm. 1891, 426; Pharm. Jr. 1883, 69.
G. pedunculata Roxb. (B.-Tikul).
G. purpurea Roxb. (Bo.-Kokum); Birdwood, Veg. Prod. Bombay.
G. xanthochymus Hook. (H.-Dampel, B.-Tamal, Bo.-Jharambi, M.-Chita-kamraku); in bilious conditions.
Gardenia campanulata Roxb.; Rubiaceæ; (Burm.-Hsathanpaya); cath., anthelm.
G. floribunda Roxb. (S. & Bo.-Ananta, H.-Paidithagara); roots—in snake-bite, miscarriage.
G. florida Linn. (S.-Gandharaj, M.-Karinga); antiper., cath., anthelm., antisp., externally antisep., root—in dyspep. and nervous disorders; bitter substance gardenin.

Gardenia gummifera Linn. (S.-Pindava, H., B. & M.-Dikmali); used in fever, dyspep., anthelm.; gum dikenali.

G. lucida Roxb. (H. & Bo.-Dikmali); use same as G. GUMMIFERA.

G. turgida Roxb. (H.-Thanella, Bo.-Khurpendra, M.-Manjunda); for indign. in children; Pharm. Jr. 1912, 391; J. C. S. 1925, 2176.

Galidium cartilagineum Gaill.; Algæ; (H.-China-ghas); demulc., mucil., medium for growing germs.

Garuga pinnata Roxb.; Burseraceæ; (H.-Ghogar, B.-Joom, Bo.-Kurak, M.-Kariverubu-maram); stomch., astrin., useful in asthma.

Gaultheria fragrantissima Wall.; Ericaceæ; oil—in rheum., neuralgia, flavouring agent; Schim. Ber. 1911, Oct., 97; 1912, April, 129; Ind. For. Rec. 1917.*

About five species are uninvestigated.

Gendarussa vulgaris Nees.; Acanthaceæ; (S.-Nilanirgundi, H.-Kalabashmib, M.-Karunochhi); bark—emetic., leaves—antiper., alter. root—in dysen., rheum. and fevers; alk.; Meded. Lands Plantent, 1897, 74; 1899, 55 and 137.

Geniosporum prostratum Benth. Labiatæ; (M.-Nazel-nagai); febge.

Gentiana chirayita Roxb.; Gentianaceæ; bitter, antiper., astrin.; bitter substance *chiratin*, *ophelic acid*; Arch. Pharm. 1869, 213; Pharm. Jr. 1919, 82.†

G. dahurica Fisch. (Ind. Baz.—Gul-i-ghafis); properties, similar to G. KURROO.

G. decumbens Linn.; tincture of the plant—stomch.

G. kurroo Royle. (H. & B.-Karu, Bo.-Pashan-veda); tonic, stomch.* †

G. olivieri Griseb.

G. tenella Fries. (P.-Teeta); decoct. of the plant in fevers.

About thirty five species of Gentiana are uninvestigated.

Geophila reniformis Don.; Rubiaceæ; (Sylhet.-Kudi-mankuni); similar to IPECACUANHA.

Geranium nepalense Sweet.; Geraniaceæ; (H. & P.-Bhánda); astrin., used in certain renal diseases.

G. ocellatum Camb. (H.-Bhanda); astrin., diur.

G. robertianum Linn.; hæmostatic, applied to tumours and ulcers, given in gravels, ague and jaundice; bitter substance *geranin*; Pharm. Ztg., 1924, 597; Ber. Bot. Ges. 1917, 591.

G. wallichianum Sweet. (H.-Laljahri); astrin., applied externally to eyes; Jr. Soc. Chem. Ind. 1890, 260.

About ten species of Geranium are uninvestigated.

Gerish elatum.; Rosaceæ; (Kash.-Goglemool); root—astrin., tonic, antisep.

G. urbanum. (Kash.-Goglemool); astrin., tonic, antisep.

Geum eletum Wall.; Rosaceæ; (Kash.-Goglimool); astrin., used in dysen. and diar.

G. urbanum Linn.; astrin., used in dysen. and diar.

Girardinia heterophylla Dcne.; Urticaceæ; (M.-Anachoriyan); leaves—specific in headache, swellings of joints, decoct.—given in fever.

Gironniera reticulata Thwaites.; Urticaceæ; (M.-Koditani, Ind. Baz.-Narakiya wood); used internally in itch and other cutaneous eruptoins; cryst. substance like methyl-indole or skatole; Pharm. Ind., Vol. III, 317.

Gisekia pharnaceoides Linn.; Ficoideæ; (S. & B.-Valuka, H.-Balukasag, Bo.-Valuchi-bhaji, M.-Manalie-kirai); arom., aper., anthelm.; *gisekia*, tann.; Pharm. Ind., Vol. II, 106.

Glinus lotoides Linn.; Ficoideæ; (P.-Poprang, Bo.-Kothuk); in diar.; Murray, Drugs of Sind.

Glochidion zeylanicum A. Juss.; Euphorbiaceæ; (M.-Kumbalmarom); fruits—cooling, restor., leaves—in itches.

Gloriosa superba Linn.; Liliaceæ; (S.-Sukra puspita, H.-Kalihari, B.-Bishlanguli, Bo.-Karianag, M.-Agnisikha); root—purg., cholag., anthelm., used in leprosy, piles, colic in snake and scorpion bites, gonor.; alks. superbine, gloriosine; I.M.G. 1880 Oct.; Meded. Lands Plantent 1899, 71; J. C. S. 1915, 835; Ber. 1920, 2069.†
Glossocardia linearifolia Cass.; Compositæ; (S.-Pithari, H.-Seri, Bo.-Patharsuva, M.-Parapalanam); emmen.
Glossogyne pinnatifida DC.; Compositæ; (Santh.-Barangom-bir-Barangom); in snake-bite and scorpion-sting.
Glycine hispida maxim.; Leguminosæ; (H.-Bhat, B.-Gari-kulay, P.-Bhut); root—astrin.
G. labialis Linn.
Glycosmis pentaphylla Correa; Rutaceæ; (S.-Vananimbuka, H.-Bannimbu, B.-Ash-shoura, Bo.-Kirmira, M.-Gonji); wood—used in snake-bite.
Glycyrrhiza glabra Linn.; Leguminosæ; (S.-Yashti-madhu, H.-Jethi-madh, B. & Bo.-Jashti-madhu, M.-Atimaduram); tonic, laxt., demulc., used in genito-urinary diseases, cough and in scorpion-sting; glycyrrhizin; Arch. Pharm. 1907, 97; 1908, 545; 1911, 144; Amer. Jr. Pharm. 1921, 481." †
Gmelina arborea Linn.; Verbenaceæ; (S.-Gumbhari, H.-Kambari, B.-Gaenari, Bo.-Shewun, M.-Gumadi); bitter tonic., stomch., laxt., used in snake-bite and scorpion-sting.
G. asiatica Linn. (S.-Biddari, H.-Badhára, Bo.-Láhán-shivan, M.-Nilacumal); bitter, astrin.; glucd.; Meded. Lands Plantent, 1898, 156.
Gnaphalium luteo-album Linn.; Compositæ; (P.-Bálraksha); leaves—used in medicine.
Gomphia angustifolia Vahl.; Ochnaceæ; (Malay.-Valermani); roots and leaves—bitter tonic, stomch. and sedative.
Gordonia obtusa Wall.; Ternstrœmiaceæ; leaves—stim., similar to tea; cryst. alk., like caffeine; Pharm. Ind., Vol. I, 190.
Gossypium arboreum Linn.; Malvaceæ; (H.-Nurma, P.-Papas); root—used in fever, seeds—in gleet, catarrh, consumption; Jr. Soc. Chem. Ind. 1899, 161; 1909, 2131; 1916, 145 and 1191, Jr. Amer. C. S. 1923, 1944; 1924, 405; 1925, 1731.†
G. herbaceum Linn. (S.-Karpas, H., B. & Bo.-Kapas, M.-Parutti); seeds—demucl., laxt., expect., aphrodis., root and bark—emmen., galact., leaves—used in scorpion-sting and snake-bite; quercetin, betaine, choline, salicylic acid, etc.; Jr. Amer. C. S. 1917, 777; 1920, 1197; 1926, 2721.†
Gouania leptostachya DC.; Rhamneæ; (Sikkim.-Batwasi); leaves—poultice for sores; alk.; Bull. Bot. Gard. Kew., 1909, 397.
Gracilaria lichenoides Grev.; Algæ; (Ind. Baz.—Chinaighas); emol., demulc., alter.; iodine; Pharm. Ind., Vol. III, 640.
Grangea maderaspatana Poir.; Compositæ; (H.-Mustaru, B.-Namuti, M.-Masipatri); leaves—stomch., antisp., anodyne, emmen.
Graptophyllum hortense Nees.; Acanthaceæ; alk., Meded. Lands Plantent 1897, 74; 1899, 55 and 137.†
Gratiola monniera Linn. see HERPESTIS MONNIERA.
Grewia asiatica Linn.; Tiliaceæ; (S.-Parusha, H. & B.-Phalsa); fruit—astrin., cooling; root bark—demulc., in rheum.
G. microcos Linn.; Tiliaceæ; (M.-Kottei); used in indign., typhoid fever, dysen. and syphilitic ulceration of the mouth and in small pox, eczema and itches.
G. polygama Roxb. (H.-Kukurbicha, Bo.-Gowali); in dysen.
G. scabrophylla Roxb. (Bo.-Khatkhati); subst. for Althæ.
G. tiliæfolia Vahl. (S.-Dharmana, H. & B.-Dhamani, Bo.-Dámana, M.-Tharra); bark—emetic, used in dysen. and opium poisoning

Grewia villosa Willd.; (Santh.-Tarse kotap, P.-Jalidar); root—used in diar.
Grislea tomentosa Roxb.; Lythraceæ; (B. & Bo.-Dhaiphul, P.-Dha), astrin., in headache, diar. and fever.
Guazuma tomentosa Kunth.; Sterculiaceæ; (B.-Nepal tunth, M.-Tainpuchili); bark—sudorific, tonic, demucl., useful in skin diseases and elephantiasis.
Guizotia abyssynica Cass.; Compositæ; (H. & B.-Ramtil, M.-Kattellu); oil—in rheum.; Jr. Soc. Chem. Ind. 1898, 491.
Gymnema latifolium Wall.; Asclepiadeæ; leaves—HCN-glucd.
G. sylvestre Br.; (S.-Meshasringi, H. & B.-Merasingi, Bo.-Kavali, M.-Shiru kurunja); in diabetes; gymnemic acid.; Pharm. Ztg. 1891, 401; Proc. Chem. Soc. 1904, 87 and 604; J. C. S. 1904, 624.
Gymnosporia montana Benth.; Celastrineæ; (S.-Vikankat, H.-Vingar, P.-Kharai); bark applied to destroy pediculi.
G. spinosa Hk. f.; used in toothache; Stewart, Punj. Plants.
Gymnostachyum febrifugum Benth.; Acanthaceæ; (M.-Nelamuchchala); root—febge.
Gynandropsis pentaphylla DC.; Cappardeæ; (S.-Surjávarta, H.-Karaila, B.-Hurhuria, Bo.-Tilávana, M.-Taivela); used in fever, leaves—rubft., vesicant, in scorpion-sting and snake-bite; essen. oil; Dragendorff, Heilpflanzen, 260.
Gynocardia odorata R. Br.; Bixinæ; (H., B. & Bo.-Chaulmoogra); in leprosy; glucd. gynocardin; dry seeds—with about 9% water produces upto 0,8% HCN and fresh seeds—over 1% HCN; Pharm. Weekbl. 1905, 102; Proc. Chem. Soc., 1904, 836, 838 and 851; 1905, 88 and 176; J. C. S., 1905, 349; 1905, 884 and 896; 1910, 1285.

Hæmatoxylon campechianum Linn.; Leguminosæ; (B.-Bokkan, M.-Partanga); astrin., tonic, used in chr. diar., dyspep., leucor.; Proc. Chem. Soc. 1900, 45; J. C. S. 1900, 423.
Hagenia abyssynica Lam.; Rosaceæ; (Bo.-Kassu); anthelm., abortif.; kosin, kosotoxin; Arch. Pharm., 1894, 50; 1899, 481; 1901, 672; 1908, 523; Bull. Chim. Pharm., 1897, 609.
Haloxylon multiflorum Bunge; Chenopodiaceæ; (P.-Lana).
Haplanthus tentaculatus Nees.; Acanthaceæ; (H.-Kala-kirayat, Bo.-Jhankara).
H. ventricillaris Nees.; in fever.
Hardwickia pinnata Roxb.; Leguminosæ; (M.-Kolavu); in gonor.; use similar to Copaiba balsam; essen. oil; Schim. Ber., 1905, April, 86; Arch. Pharm., 1908, 71.
Hedera helix Linn.; Araliaceæ; (H.-Lablab, P.-Banda, Kash.-Karmora); berries—purg.; 0.225 mg. arsenic oxide in 1 kg. leaves; Pharm. Weekbl. 1921, 1482 (C. C. 1922. II, 113).
Hedychium spicatum Ham.; Scitamineæ; (S.-Kapur kachili, H.-Sitruti, Bo.-Kapur kachar, M.-Shimai-kich-chilik-kishangu); stomch., carmin., tonic, stim., used in dyspep. and snake-bite; essen. oil. methyl paracumarin acetate, cinnamic ethyl acetate; Deutsch. Amer. Apoth. Ztg., 1884, 560; Jr. Pharm. Soc., 1924, Nr. 513, 2.†
Hedyotis auricularia Linn.; Rubiaceæ; (B.-Muttia-lata, Bo.-Dapoli, M.-Kudal-churiki); emol., used in dysen. and cholera; Ind. Sci. Congress 1930.*
H. hispida Retz.
H. umbellata Lamk.; leaves—expect., decoct. used to wash poisonous bite.

Hedysarum alhagi Linn.; see ALHAGI MAURORUM.
H. gangeticum Linn.; see DESMODIUM GANGETICUM.
H. purpureum Roxb. (Santh.-Baephol); used in fainting and convulsions.
H. triflorum Linn.; see DESMODIUM TRIFLORUM.
H. tuberosum Roxb.; see PUERARIA TUBEROSA.
About 45 species of Hedyotis are uninvestigated.
Helianthus annuus Linn.; Compositæ; (S.-Suria-mukhi, H.-Surajmukhi, B.-Surja-mukhi, Bo.-Surajmaki, M.-Aditya bhakti-chettu); in scorpion-sting.
Helicteres isora Linn.; Sterculiaceæ; (S.-Mriga-sringa, H.-Marori, B.-Atmora, Bo.-Kevani, M.-Valumbirikai); demulc., astrin., used in dysen., diabetes and snake-bite.*
Heliotropium eichwaldi Steud. (H. & P.-Nilkattei, Kash.-Chirghas); for cleansing ulcers and in scorpion-sting and snake-bite; toxic alk.; Amer. Jr. Pharm., Feb., 1891.
H. europæum Linn.; emetic, in snake-bite.
H. indicum Linn. (S.-Hastisunda, H. & B.-Hatisura, Bo.-Burundi, M.-Tel-kodukki); applied to boils and in stings of insects and reptiles; alk.; Pharm. Ind., Vol. II, 526.
H. ophioglossum Stocks.; similar to other species of HELIOTROPIUM.
H. strigosum Willd. (H.-Chitiphul); laxt., diur., used in snake-bite.
H. undulatum Vahl. (P.-Pipat-buti); used in bites of scorpions and venomous reptiles.
Helleborus niger Linn.; Ranunculaceæ; (S.-Katurohini, H.-Khorasani kutki, B.-Kalakutki, M.-Kádá-garuganie); cath., emmen., anthelm., used as local anæsthetic, cardiac tonic like digitalis, anthelm.; in apoplexy and skin diseases; helleborin; Arch. Pharm., 1897, 414; 1910, 463; 1927, 338.†
H. virides Linn. (S.-Krishna bhedi, H.-Kalikatuki, Bo.-Kulki, M.-Katu-karohini); glucd. helleborin; Pharm. Jr. 1853, 74; Arch. Pharm. 1910, 463; 1927, 338.
Helminthostachys zeylanica Hook.; intox., anodyne, used in sciatica; Prain, Beng. Plants.
Hemidesmus indicus R. Br.; Asclepiadeæ; (S.-Ananta, H.-Magrabu, B.-Anantamul, M.-Nannari); blood-purifier, in nutritional disorders, syphilis, rheum. and in scorpion-sting and snake-bite.* †
Hermodactylus see COLCHICUM LUTEUM.
Hernandia peltata Meissn.; Laurineæ; (Mysore.—Uparanthi); bark and leaves—cath., depilatory; essen. oil; Schim. Ber. 1910, Oct., 137; 1915, April, 54; Ber. 1911, 815; Jr. Soc. Chem. Ind. 1916, 1089.†
Herpestis monniera H. B. K.; Scrophularineæ; (S.-Brahmi, H.-Brambhi, B.-Brihmisák, M.-Nirbrami); cardiac and nerve tonic, used in asthma and in snake-bite.*
Heterophragma roxburghii DC., Bignoniaceæ; (Bo.-Warras, M.-Baro-kala-garu); used as drink in viper-bite.
Heynea sumatrana Miq.; Meliaceæ; tox. bitter substance; Meded. Lands Plantent, 1899, 80, 121.
H. trijuga Roxb.; (B.-Kapia kushi, Bo.-Limbara); bark and leaves—bitter, tonic.
Hibiscus abelmoschus Linn.; Malvaceæ; (S.-Zatákasturiká, H.-Mushk-dana, B.-Kasturidana, Bo.-Mishkdána, M.-Kattuk-kasturi); cooling, tonic, carmin., used in snake-bite; essen. oil; Schim. Ber. 1887, Oct. 35; 1888, April, 29; 1893, Oct., 45; 1912, April, 89; 1914, April, 68. Ber. 1927, 902.
H. cannabinus Linn. (S.-Náli, H.-Patsan, B.-Mestapat, Bo.-Ambári, M.-Pulichi); flowers—in biliousness and constipation; Pharm. Weekbl. 1922, 1926.

Hibiscus esculentus Linn. (S.-Gandhamula, H.-Bhindi, B.-Dheras, Bo.-Bhanda, M.-Vendi); emol., demulc., diur., in gonor.; Chem. Ztg. 1900, 871; Jr. Amer. C. S. 1920, 166; Arch. Pharm. 1871, 140.†
H. furcatus Roxb. (M.-Konda gongura); roots—cooling.
H. micranthus Linn. (Bo.-Chanak, M.-Peru-maddi); febge.
H. populneus Linn.; see THESPESIA POPULNEA.
H. rosa-sinensis Linn. (S. & B.-Jabá, H.-Jasoon, Bo.-Jasavanda, M.-Sappat-tup-pu); subst. for Althæa.
H. subdariffa Linn. (H. & Bo.-Lalambari, B.-Mesta, M.-Shivappu-káshuruk-virai); emol., demulc., cholag.; organic acids; J. C. S., 1909, 1855.
H. tiliaceus Linn. (B.-Chelwa, Bo.-Bellipata); root—febge.
Hippocratea indica Willd.; Celastrineæ; alk.; Bull. Inst. Bot. Buitenzorg, 1902, XIV. 17.
Hippophæ rhamnoides Linn.; Elægnaceæ; (H.-Dhurchuk, P.-Neichak); fruit—valuable for lung complaints; Ber. 1899, 3351.
H. salicifolia Don. (P.-Dhurchuk); used in lung diseases.
Hiptage madablota Gærtn.; Malpighiaceæ; (S.-Madhabi, H. & B.-Madhavilata, Bo.-Haladwail, M.-Vadlayárála); leaves—useful in chr. rheum., skin diseases and asthma; glucd. hiptagin; Bull. Jard. Bot. Buitenzorg, 1920, 187.†
Hitchenia caulina Baker; Scitamineæ; (H. & B.-Tikhur, Bo.-Tavakhir); Indian arrowroot.
Holarrhena antidysenterica Wall.; Apocynaceæ; (S.-Kutaja, H.-Karchi, B.-Kurchi, Bo.-Pandhrakura, M.-Kashappu-vetpalarishi); used in scorpion-sting, dysen., diar., fevers, flatulence, in bilious affections, hæmorrhoids; alks. conessine, kurchine, kurchicine; J. C. S. 1926, 2123; Jr. Ind. C. S. 1928, 477; Arch. Pharm. 1932, 100.*
Holigarna arnottiana Hook. (Bo.-Bibu); Anacardiaceæ.
H. longifolia Roxb. (B.-Barola, Bo.-Hulugiri); poisonous.
Holoptelea integrifolia Planch.; Urticaceæ; (H.-Pipri, Bo.-Vavala, M.-Aya); used in rheum.
Holostemma rheedei Wall.; Asclepiadeæ; (Bo.-Dudali, Santh.-Apung, M.-Palay kirai); roots—cooling, alter., used in eye diseases.
Homalomena aromatica Schott.; Gramineæ; (B.-Kuschu gundubi); arom., stim.
Homonoia riparia Lour.; Euphorbiaceæ; (S.-Pashanabedaka, M.-Cheppunjerinjal); decoct. of the root—used in piles, stone in bladder, gonor., syphilis and thirst, laxt., diur.†
Hopea odorata Roxb.; Dipterocarpeæ; (Burm.-Thengan); styptic; copal-like resin; Bull. Soc. Chim. 1919, 579; 1920, 71.
Hordeum vulgare Linn. syn. H. sativum Pers.; Gramineæ; (H.-Jan, B.-Jab); As—55 mg. in 100 g. dry and 50 mg. in 100 g. fresh plant; Compt. Rend. 1914, 268 (C. C. 1914, II, 885).
Hoya viridiflora Roxb.; Asclepiadeæ; see DREGEA VOLUBILIS.
Hugonia mystax Linn.; Lineæ; (M.-Agure); root—externally for inflam., internally as febge., anthelm., antid. to snake-bite.
Humboldtia vahliana Wight.; Leguminosæ; (S.-Jelavedesa, M.-Nirvanchi); bark—used in biliousness, leprosy, ulcers and epilepsy.
Humulus lupulus Linn.; Urticaceæ; bitter, arom., astrin.; essen. oil, bitter substance, choline, asparagine; J. C. S., 1913, 1267; Arch. Pharm., 1880, 345; Pol. Jr. 1874, 67; Pharm. Ztg. 1903, 58; J C. S. 1903, 505; 1913, 1267; 1928, 785.†
Hunteria corymbosa Roxb.; Apocynaceæ; tox. alk. in bark 0.3%.
Hura crepitans Linn.; Euphorbiaceæ; seeds—emetic, purg.; toxic substance crepitin; Ber. Pharm. Ges. 1906, 176; Ann. Inst. Past., 1909, 745.

Hydnocarpus alpina Wight.; Bixineæ; (Bo.-Kastel, M.-Torathi); Pharm. Weekbl., 1912, 1049.
H. anthelmintica Pierre.; used is leprosy; J. C. S. 1905, 884; 1907, 557.*
H. castanea Hk. f. & T.
H. octandra Thw.
H. odorata Lind.; Proc. Chem. Soc. 1904, 137; J. C. S. 1904, 836, 851; 1910, 543.
H. venenata Gærtn.; (H.-Jangli badam, Bo.-Kauti, M.-Niradimattu); oil —subst. for chaulmoogra; Ber., 1890, 3537; Phil. Jr. Sci., 1916, A. 75; 1923, 543.
H. wightiana Blume. (Bo.-Kava, M.-Yetti); used in leprosy; J. C. S., 1905, 884; 1907, 557; Jr. Amer. C. S. 1920, 2626; Jr. Ind. Inst. Sci. 1923, 133; Phil. Jr. Sci. 1929, 449.*
Hydrangea aspera Buch.; Saxifragaceæ; fresh plant—HCN; Schweiz. Apoth. Ztg., 1919, 267.
Hydrocotyle asiatica Linn.; Umbelliferæ; (S.-Manduka parni, H.-Brahmamanduki, B.-Tholkuri, Bo.-Karivana, M.-Vallarai); in secondary and tertiary syphilis, skin diseases, rheum.; bitter subst.; Jr. de Pharm., 1855, 47.
H. rotundifolia Roxb.; (S.-Mandukaparni, H.-Khulkhuri, B.-Gimasak, M.-Ballarikerai); use similar to H. ASIATICA.
Hydrolea zeylanica Vahl.; Hydrophyllaceæ; (S.-Langali, B.-Isha langula); antisep., used as poultice.
Hygrophila spinosa T. And.; Acanthaceæ; (S.-Kakilakshya, H.-Tálmakhána, B.-Kuliakhárá, Bo.-Tálim khana, M.-Nirmalli); used in rheum. and urinary affections; phytosterol; Meded. Lands. Plantent., 1897, 74; 1899, 137.
Hymenodictyon excelsum Wall.; Rubiaceæ; (H.-Bhaulan, Bo.-Kala kadu, M.-Sagapu); astrin; tox. alk. hymenodictine, bitter substance aesculin; Pharm. Jr., 1883, 311; 1884, 195; Phil. Jr. Sci., 1917, 167.†
Hyoscyamus muticus Linn.; Solanaceæ; alks.; Proc. Chem. Soc., 1899, 240; 1900, 207; J. C. S., 1901, 71; Pharm. Jr. 1903, 159; Ber., 1907, 3869.
H. niger Linn.; (S.-Parasikaya, H.-Khurasani-ajvayan, B.-Khorasani ajowan, Bo.-Khorasani-owa, M.-Khorasani-yomam); laxt., carmin., sedative, hypnotic, used in asthma; alks.; Ann. Chem., 1833, 270; 1871, 98; 1881, 282, Trans. Chem. Soc. 1910, 1329; 1913, 722.*
H. reticulatus Linn.; alk.; Arch. Pharm., 1928, 449.
H. pusilus Linn.
Hypecoum procumbens Linn.; Fumariaceæ; use similar to FUMARIA OFFICINALIS; alk.; Jr. Pharm. Chim. 1891, 3501; Comp. Rend. 1892, 1122.
Hypericum patulum Thunb.; Hypericineæ; (H.-Tumbhul); seeds—arom., stim.
H. perforatum Linn. (H. & P.-Bassant); astrin., arom., purg., anthelm., emmen., in diar.; essen. oil; Jr. Amer. Pharm. Assoc., 1927, 824; J. C. S., 1918, 125; Arch. Pharm., 1925, 161†
Hypoxis orchioides Kurz.; Amaryllideæ; roots—alter., tonic, used in dysurea and menor.; see Curculigo orchioides.
Hyssopus officinalis Linn.; Labiatæ; (H.-Zufah-yabis); leaves—stim., stomch., expect., diaphor., emmen.; glucd., essen. oil; Schim. Ber., 1925, 58; Pharm. Centralh., 1915, 135; Pharm. Post 1917, 773; Helv. Chim. Act. 1925, 519.†
H. parviflora Benth.; (H.-Zupha).

Ichnocarpus frutescens Br.; Apocynaceæ; (S.-Sárivá, H. & B.-Dudhi, M.-Illu-katte); use similar to HEMIDESMUS INDICA.

Ilex aquifolium Linn.; Ilicineæ; leaves—emol., diur., berries—purg., emetic, diur.; glucd., bitter substance, Ann. Chem. 1857, 346; 1848, 253; Arch. Pharm. 1894, 532.
I. paraguayensis St. Hilaire; purg.; Ann. Chem. Pharm. 1843, 366; Arch. Pharm. 1893, 616.
Illicium griffithii Hk. f. & T.; Magnoliaceæ.
I. religiosum S. & L.; (H.-Anásphal, Bo.-Bádián, M.-Anáshuppu); essen. oil; Ber., 1881, 1720; 1886, 1097, Jr. Amer. Pharm. Assoc. 1926, 861.†
I. verum Hook.; essen. oil—Schim. Ber., 1893, April, 56; 1910, April, 99; Amer. Jr. Pharm. 1885, 426; Bull. Soc. Chim., 1902, 990.
Impatiens balsamina Linn.; Geraniaceæ; (H.-Gul-mendi, P.-Bontil, B.-Dupati, Bo.-Teradá); Ber. Bot. Ges., 1908, 438.
I. chinensis Linn.; (M.-Pylee); used in burns and internally in gonor.
I. roylei Walp.
Indigofera anil Linn.; Leguminosæ; (S.-Visha-shodhani, H.-Vilaiti-nil, M.-Shimaiya-viri).
I. argentea Linn. (S.-Kalaklitaka, H.-Surmainil, M.-Kat-averi); roots and leaves—bitter tonic, seeds—anthelm.
I. aspalathoides Vahl. (S.-Shiva's nil, P.-Nil, M.-Shevenar-vaymbu); cooling, demulc., alter.
I. cærulea Roxb.
I. enneaphylla Linn. (S.-Vasuka, Bo.-Bhingule, M.-Adambedi); antiscor., alter., diur.
I. galegoides DC.; Leaves—HCN-glucd.; Schim. Ber., 1894, Oct. 75; 1896, April, 75.
I. glabra *Linn.*; leaves—bitter tonic, febge., applied externally as emol.
I. glandulosa Willd.; Leguminosæ; (Bo.-Vekhariyo, M.-Barapatam); seeds —nutri., tonic.
I. linifolia Retz. (H. & P.-Torki, B. & Bo.-Bhangra); given in febrile eruptions and amenor.
I. paucifolia Delile. (M.-Kuttukkárchammatti); antisyp., antiphl., used in rheum., antid to poisons.
I. pulchella Roxb (H.-Sakena, Bo.-Baoli); in cough and pain in chest.
I. tinctoria *Linn.* (S.-*Nilika*, H. & B.-*Nil*, Bo.-*Nila*, M.-*Nilam*); used in scorpion-sting, whooping cough, and skin diseases, prophylactic against hydrophobia, in epilepsy; glucd. indican; J. C. S., 1907, 279 and 1715; Proc. Chem. Soc., 1907, 30 and 116.†
I. trifoliata Linn.; seeds—alter., astrin. aphrodis., tonic, used in rheum. and leucor.
I. trita Linn. (Bo.-Vekhario).
Inula helenium Linn.; Compositæ; (Pers. & Arab.-Rasan); used in chr. broncht. and rheum; essen oil, bitter principle, benzoic acid; Compt. Rend., 1893, 514; Amer. Chem. Jr., 1904, 69; Shim. Ber., 1912, April, 23; 1915, April, 7.†
I. racemosa Hook. (Arab.-Rasan); used in vet. medicine as tonic, stomch; ref. same as of I. HELENIUM.
I. royleana DC.; used to adulterate S. LAPPA.
Ionidium suffruticosum Ging.; Violaceæ; (S.-Chárati, H.-Ratan-purus, B.-Nunbora, M.-Orilai-hámarai); tonic, diur., demulc., in scorpion-sting; alk.; Pharm. Ind. Vol. I, 140.
Ipecacuanha; see PSYCHOTRIA IPECACUANHA.
Ipomæa aquatica Forsk.; Convolvulaceæ; (S.-Kalambi, B.-Kalmisak, Bo.-Nalichi baji, M.-Sarkarei-valli); emetic, purg., antid. to opium and arsenical poisoning.†
I. batatas Lamk. (H. & P.-Shakar kund, B.-Ranga-alu, Bo.-Ratalu, M.-Sakkarei-vellei-kelangu); root—laxt.; Ber., 1890, 1406; Arch. Pharm. 1909, 184; Jr. Biol. Chem. 1915, 503.

Ipomæa biloba Forsk. (S.-Vridhadarak, H.-Dopatilata, B.-Chhagalkhuri, Bo.-Marjavel, M.-Chevulapilli); astrin., pungent, alter., tonic, diur.; alk.; Pharm. Ind., Vol. II, 539.

I. bona-nox Linn. (S.-Pathmapu-todami, H.-Dudhia kalmi, B.-Ilál-kalmi, Bo.-Gulchandni, M.-Nagamughatei); in snake-bite; Ber. Pharm. Ges. 1910, 481.

I. campanulata Linn.; antid. to snake-poison.

I. cymosa Rœm. (M.-Kolavarvalli); seeds—used in medicine.

I. dasysperma Jacq.; seeds—used in hydrophobia.

I. digitata Linn. (S.-Bhumikushanda, H.-Bilaikand, B.-Bhumikumrá, Bo.-Bhuikohala, M.-Nelli-kumbabe); root—tonic, alter., demulc., in scorpion-sting; resin similar to Jalap resin.

I. dissecta Willd.; HCN in sap; Arch. Pharm., 1909, 184.

I. eriocarpa Br.; (S.-Nakhari, M.-Pulichevidu); oil—boiled with the plant, used to cure rheum., headache, epilepsy, leprosy, ulcers.

I. fastigata Sweet.; glucd. ipomoein; Amer. Jr. Pharm., 1881, 384.

I. hederaceæ Jacq. (H., B. & Bo.-Kaladana, M.-Jirkivirai); subst. for Jalap; glucd.; Arch. Pharm. 1896, 459; Pharm. Jr. 1924, 155. Jr. Pharm. Soc. Japan, 1922, 419; Proc. Imp. Acad. Tokyo, 1926, 274.*

I. obscura Ker. (M.-Sirutali); leaves—in aphthous affections.

I. pes-tigridis Linn. (B.-Langulilata, M.-Mekamu-aduga); antid. to dog-bite, used in boils and carbuncle.

I. quamoclit Linn. (S. & H.-Kamalata, B.-Tarulata, M.-Vishnu krant); cooling, leaves—in carbuncles.

I. reniformis Chois. (S.-Mooshakarni, H.-Mushakani, B.-Indurkani, M.-Perre-taykiray); diur., alter., used in rheum., neuralgia.

I. sepiaria Kœn. (B.-Bonkalmi, M.-Thali-kirai); antid. to arsenic.

I. sinuata Ort.; HCN in sap; Flückiger, Pharmacogn, 1891, 1012.

I. tridentata Roth. (S.-Prasarini, M.-Mudiyakunthal); used in rheum., piles and urinary disorders, tonic and laxt.

I. turpethum Br. (S.-Triputá, H.-Nisoth, B.-Dudh kalmi, Bo.-Nishotar, M.-Shivadai); purg., used in scorpion-sting and snake-bite; glucd., turpethin; Ann. Chem. 1866, 41; Jr. de Pharm. 1822, 131.*

I. uniflora Rœm.; purg., used in bilious dyspep.

I. vitifolia Sweet. (Bo.-Nawal); cooling, applied to inflamed eyes; glucd.; Pharm. Weekbl. 1906, 907.

About thirty species of Ipomæa are uninvestigated.

Iris ensata Thunb.; Irideæ; (H.-Irisa).

I. fœtidissima Linn. (H.-Dadmari, B.-Dábiduba, M.-Kochillittipulla); cure for ringworm; essen. oil, bitter substance; glucd.; Jr. Pharm., 1834, 320; Compt. Rend., 1927, 475.†

I. germanica Linn. (S.-Padma-pushkara, Ind. Baz.-Keore-ká-mul); root—alter., aper., diur., cath., used in gallbladder diseases; essen. oil; Schim. Ber., 1907, April, 53; 1908, Oct. 62, glucd. iridin; Ber., 1893, 2010; J. C. S., 1928, 22.

I. kumaonensis Wall. (P.-Piáz); root and leaves—in fever.

I. nepalensis Don. (H. & P.-Chiluchi); aper., diur., useful in bilious obstructions.

About ten species of Iris are uninvestigated.

Isopyrum thalictroides Linn.; Ranunculaceæ; alk. isopyroine, HCN; Jr. Amer. C. S., 1903, 99; Compt. Rend. Soc. Biol., 1922, 50 (C.C. 1922. I. 697); Compt. Rend. 1919, 316.

Ixora coccinea Linn.; Rubiaceæ; (S.-Bandhuka, H. & B.-Rangan, Bo.-Pentgul); sedative, stomch., intestinal antisep., cholag.

I. parviflora Vahl (H.-Kotagandhal, B.-Rangan, Bo.-Kurat, M.-Shulundu-kora); used in whooping cough.

Jasminum angustifolium Vahl. · Oleaceæ; (S., H. & B.-Bon-mallika, M.-Chattumallika); used in ringworm.
J. arborescens Roxb. (H.-Chameli, B.-Barakunda); expect., leaves—bitter, astrin., tonic and stomch.
J. auriculatum Vahl.; used in *consumption*.
J. chrysanthemum Roxb. (*S.-Hemapuspika*, H.-Peetmalati, Bo.-Svarnajui) antibil., astrin., used in ringworm.
J. flexile Vahl. (M.-Mullu-gundu); bitter glucd.; Pharm. Ind., Vol. II, 380.
J. grandiflorum Linn. (S. & H.-Játi, B.-Chameli, Bo.-Chambeli, M.-Jaji); anthelm., diur., emmen., in scorpion-sting; alk., salicylic acid; Pharm. Ind., Vol. II, 378; essen. oil; Chem. & Drug. 1929, 778; Chem. Ztg. 1910, 912; Jr. Soc. Chem. Ind. 1909, 227.†
J. humile Linn. (S.-Svarnajuthiká, H.-Pitmalti, B.-Svarnajui, M.-Pachcha-adavimolla); used in fistula.
J. officinale Linn. (S. & B.-Mallika, H.-Motiya); nerve sedative, fruits—narcotic.; alk. jasmin; essen. oil; Buchn. Repert Pharm. 1834, 101; Schim. Ber., 1929, 51.
J. pubescens Willd. (S.-Kunda, H. & B.-Kundphul, Bo.-Mogra); emetic, *antid. to cobra venom.*
J. ritchiei Clarke.; leaves—used in toothache, flowers—in piles.
J. rottlerianum Wall.; Oleaceæ; (S.-Vanamalliga, M.-Kattumalligei); leaves—used in eczema.
J. sambac Ait. (S.-Mallika, H.-Mugra, B.-Bel, Bo.-Mogri, M.-Millippu); galact.
Jateorhiza calumba Miers.; Menispermaceæ; bitter, tonic, antiper., anthelm.; bitter substance columbin.; Arch. Pharm. 1902, 146; 1925, 294; Ann. Chem. 1907, 363; Ber. 1926, 1486.
Jattopha curcas Linn.; Euphorbiaceæ; (S.-Kanana-eranda, H. & B.-Baghbharenda, Bo.-Mogalie eranda, M.-Kattamanakku); hæmostatic, useful in itches, sores, purg.; tonic principle curcin; C. C., 1914, 1958; Bull. Imp. Inst. 1921, 288; Pharm. Jr. 1908, 161.†
J. glandulifera Roxb. (S.-Nikumba, H. & B.-Lalbharenda, Bo.-Undarbibi, M.-Udalai); purg., used *in chr. ulcerations.*
J. gossypifolia Linn.; (M.-Chuvanna kodalavanakku); leaves—applied to boils and carbuncles, eczema and itches; decoct. of the bark—emmen.; seeds—cause insanity and act as an emetic.
J. multifida Linn.; purg., emetic; fatty oil, bitter substance; Ber Pharm. Ges., 1905, 183; 225, 181.
J. nana Dalz. & Gibs. (Bo.-Kirkundi); juice—used in ophthalmia.
Juglans regia Linn.; Juglandeæ; (S.-Akshota, H. & B.-Akhroot, Bo.-Akroda, M.-Akrottu); anthelm., antisep.; alk., barium; Amer. Jr. Pharm. 1886, 468; Ber., 1884, 1045; Jr. Amer. C. S. 1896, 609; 1903, 845; As—0,013 mg. in 100g. seeds; Compt. Rend. 1912, 893; oxalic acid in fruits; Ann. Chim. 74, 303; Chem. News. 1916, 62.†
Juniperus communis Linn.; Coniferæ; (H.-Aaraar, P.-Petthri); diur., carmin.; essen. oil, berries contain oxalic acid; Jr. Amer. C. S. 1906, 1198; Schim. Ber. 1910, Oct., 128.*
J. excelsa Bieb.; the smoke of the branches used in delirium of fever; essen. oil; Schim. Ber. 1923, 239; Tr. Sc. Chem. Pharm. Inst. Moskau. 1927, 151.
J. macropoda Boiss. (H.-Dhup); use same as J. COMMUNIS.
J. recurva Ham. (H.-Bettir, Nep.-Tupi); smoke of green wood—emetic.
Jurinea macrocephala Benth.; Compositæ; (P.-Dhup); tonic, used in fever and eruptions.
Jussiæa suffruticosa Linn.; Onagraceæ; (S.-Bhallava-anga, H.-Banlaunga, B.-Lal-ban-labanga, M.-Panalavanga); astrin., carmin., diur., anthelm.

Justicia ecbolium Linn.; Acanthaceæ; (H.-Oodoojati); useful in jaundice, menor., gout and dysuria.
J. gendarussa Linn. (S.-Nila-nirgundi, H.-Nili-nargandi, B.-Jagatmadan, Bo.-Kala-adulsa, M.-Karu-noch-chi); used in rheum.
J. picta Roxb. (M.-Ysjudemaram); leaves—emol., resol., used in scorpion-sting, inflamed breast.; alk.; Meded. Lands Plantent, 1897, 74; 1899, 55 and 137.
J. procumbens Linn. (Bo.-Ghati-pitpáprá); subst. for 'Pitpapra' (Fumaria official); laxt., diur., used in ophthalmia.

Kæmpferia angustifolia Rosc.; Scitamineæ; (H. & B.-Kanján-bura); roots—used in vet. practice.
K. galanga Linn. (S.-Chandra mulika, H.-Chandra-mula, B.-Chandu-mulá, Bo.-Kapur-kuchri, M.-Kachula kalanga); tubers—stim., expect., diur., carmin.; essen. oil; Schim. Ber., 1900, Oct. 37; 1903, April, 38; Jr. Ind. Inst. Sci., 1926, 133; alk., Pharm. Ind., Vol. III, 416.
K. rotunda Linn. (S.-Bhuchampaka, H. & B.-Bhuichampa, Bo.-Bhuichampo, M.-Konda kalava); used in mumps and for wounds and bruisses; essen. oil; Schim. Ber., 1894, April 57.
Kalanchœ laciniata DC.; Crassulaceæ; (S., H. & B.-Hemsagar, Bo.-Jakhmhyát, M.-Mala-kulli); styptic, useful in wounds, ulcers and insect-bite.
K. spathulata DC. (H.-Tatára); *poisonous to goats, leaves—used in* cholera and in wounds.
Kandelia rheedii W. & A.; Rhizophoreæ; (B.-Guria); bark—in diabetes; Jr. Prakt. Chem. 1864, 361.
Kochia indica Wight.; Chenopodiaceæ; (P.-Kaura-ro); cardiac stim.
Kokoona zeylanica Thwaites.; Celastrineæ.; (Singh.-Kokun); powdered bark—in headache.
Kopsia flavida Blume; Apocynaceæ; alk.; Nederl. Tijdchrft. Pharm., 1896, 199.
Kydia calycina Roxb.; Malvaceæ; (H.-Pola, Bo.-Varanga, M.-Potari); used in rheum. and lumbago.
Kyllinga monocephala Roxb.; Cyperaceæ; (S.-Nirbishá, H. & B.-Nirbisi, Bo.-Musta); root—antid. to poisons, used in fever and diabetes.
K. triceps Rottb.; use same as K. MONOCEPHALA.

Lactuca heyneana DC.; Compositæ; (Bo.-Underá-cha-kán); subst. for Taraxacum.
L. remotiflora DC.; used as subst. for Taraxacum.
L. sativa Linn.; As, 0.023 mg. in 100 g plant; Compt. Rend., 1912, 893 (C. C. 1912. I. 1730).
L. scariola Linn. (H.-Kahoo, B.-Sáláд M.-Shalláttu); cooling, sedative, diur., hypnotic, expect.; alk., bitter substance lactucin; Bull. Imp. Inst. Lond., 1919, 37; Pharm. Jr., 1904, 186; 1905, 548; Analyst 1919, 170.†
Twenty species of Lactuca are uninvestigated.
Lagascea spinosissima Cav.; Compositæ; alk.; Pharm. Jr., 1892, Nr. 1124, 552.
Lagenandra toxicaria Dalz.; Aroideæ; (Bo.-Rukh-alu, M.-Maravara Tsjembu); very poisonous, remedy for itch.
Lagenaria vulgaris Seringe; Cucurbitaceæ; (S.-Alabu, H.-Kaddu, B.-Láu, Bo.-Kadubhopalá, M.-Shorakai); purg., scorpion-sting; saponin, fatty oil; Arch. Pharm., 1886, 863.
Lagerstrœmia flos-reginæ Retz.; Lythraceæ; (S.-Arjuna, H. & B.-Jarul B.-Taman, M.-Kodali); seeds—narcotic, bark and leaves—purg.†

Lallemantia royleana Benth.; Labiatæ; (H.-Gharee Bo.-Tukhm-i-bálangu); cooling, sedative, used in flatulence, constip.†
Lamarkia aurea Mœnch.; Gramineæ; HCN-glucd.; Jr. Pharm. Chim., 1908, (6) 542.
Laminaria saccharina Lam.; Algæ; (H.-Galpar-ka-patta); cure for goitre, scrofula and syphilis; iodine.
Lamprachænium microcephalum Benth.; Compositæ; (S.-Ajadandi, Bo.-Bramhádandi); arom., bitter.
Lansium domesticum Jack; Meliaceæ; lansinic acid (tox., heart poison) 6%; Meded. Lands Plantent., 1899, 80 & 121.
Lantana indica Roxb.; Verbanaceæ (Ajmere.-Ghaneri); leaves—for snake-bite.
L. camara Linn. (Bo.-Vhaneri, M.-Arippu); essen. oil; Schim. Ber. 1906, Oct. 77; Arch. Pharm. 1914, 252; Perf. Rec. 1925, 9.
Laportea crenulata Gaud.; Urticaceæ; (H.-Utignn, B.-Chorpata); use same as Coriander; Pharm. Jr. Trans., 1889, 993.
Lasia spinosa Thwaites; Aroideæ; (B.-Kanta-katchu, M.-Mulasari); root—remedy for affections of throat.
Lasiosiphon eriocephalus Dcne.; Thymelaceæ; (Bo.-Rametha, M.-Rámi); fish poison, bark—vesicant.
Lathræa squamaria Linn.; Scrophularineæ; glucd. rhinanthin; Beihefte. Bot. Centralb., 1902.
Lathyrus altaicus Led.; Leguminosæ;
L. aphaca Linn. (H. & B.-Jangli-matar, P.-Rawan); ripe seeds are said to be narcotic.
L. inconspicuus Linn.
L. luteus Baker.
L. pratensis Linn.
L. sativus Linn.; (S.-Triputi, H. & B.-Khesari, Bo.-Lákh); oil from seeds powerful and dangerous cath.; Compt. Rend., 1921, 252, 1142, 1202; Bull. Sc. Pharm. 1923, 604.†
L. sphæricus Retz.
Six species of Lathyrus are uninvestigated.
Launæa aspleniifolia Hook.; Compositæ; (B.-Tik-chana); root—lactag.
L. nudicaulis Hook. (P.-Batthal); cooling drink.
L. pinnatifida Cass. (Bo.-Pathri); galact., soporific, subst. for taraxacum.
Laurus nobilis Linn.; Laurineæ; (Ind. Baz.—Hab-el-ghar); emen., diar., used in leucor. and dropsy; essen. oil; J. C. S. 1864, 1; Schim. Ber., 1906, April, 45; 1919, 91.†
Lavandula burmanni Benth.; Labiatæ; (Bo.-Surpano-charo); antid. to snake poison; essen. oil; Schem. Ber. 1913, Oct. 110.
L. stœchas Linn. (H.-Dháru, Bo.-Ustukhndus); resolv., antiphl., carmin.; essen. oil; Schim. Ber., 1926, 67.
Lawsonia alba Lam.; Lythraceæ; (S.-Mendiká, H.-Hena, B.-Mehedi, Bo.-Mendi, M.-Marithondi); used in jaundice, skin diseases, leprosy and enlargement of spleen; glucd.; Jr. de Pharm., 1894, 591; Pharm. Jr. 1908, 781; Ann. Chem. 1900, 845; Apoth Ztg. 1923, 541.†
Leea crispa Willd.; Ampelideæ; (B.-Banchalta); tubers—remedy for guineaworm.
L. hirta Roxb. (S., H. & B.-Kakajangha, M.-Surapadi); bitter, acrid, stim. anthelm., in jaundice.
L. macrophylla Roxb. (S.-Dholasamudrika, H. & B.-Dholshumoodra, Bo.-Dinda); used for ringworm and guineaworm.
L. robusta Roxb. (Nep.-Galeni, Santh.-Haramada); externally as anodyne, internally in diar.
L. sambucina Willd. (H. & B.-Kakurjiwah, Bo.-Karkani, M.-Ankados); used in colic, diar., dysen., vertigo, as sudorific.

Leonotis nepetæfolia Br.; Labiatæ; (B.-Hejurchei, Bo.-Mátije, M.-Ranabheri) used in ringworm and skin diseases.

Leonurus sibiricus, Linn.; Labiatæ; (H.-Guma); febge.

Lepidagathis cristata Willd.; Acanthaceæ; (Bo.-Koli-che-chular, M.-Bhuyaterada, Santh.-Otdhomps); used in fever.

Lepidium draba Linn.; Cruciferæ; (Afgh.-Bijindak); young leaves contain HCN.

L. iberis Linn.; rubft., in rheum., seeds—in dropsy; amorph. bitter substance; Pharm. Ind. Vol. I, 110.

L. latifolium Linn. (P.-Gonyuch); antiscorb.

L. sativum Linn. (S.-Chandrasura, H.-Chansaur, B.-Halim, Bo.-Asália, M.-Alivirai); tonic, alter.; essen. oil; Arch. Pharm., 1892, 434; Ber. 1874, 1293; 1896, 1883.

Lettsomia mysorensis Clarke.; Convolvulaceæ; paste of leaves—applied externally in cough, quinsy.

L. nervosa Roxb.; antiphl., used in skin diseases; Murray, Drugs of Sind.

Leucas aspera Spreng.; Labiatæ; (H. & B.-Chota-Kalkusha, Bo.-Tamba, M.-Tumbai-cheddi); insecticide, used in cold, scabies, snake-bite.

L. cephalotes Spreng. (S.-Dronapuspi, H.-Goma madhupati, B.-Hulkasha, Bo.-Tumba, M.-Tummi); aper., stim., diaphor., insecticide; essen. oil; alk.; Pharm. Ind. Vol. III, 125.

L. linifolia Spreng. (S.-Dronapuspi, B. & H.-Hulkussa); stim., diaphor, used in rheum. and snake-bite.

L. stelligera, (Pers.-Mishk-i-taramshi); stim., carmin., emmen.

L. zeylanica Br. (Sing.-gatta-tumba) used in scabies and skin diseases.

Leuconotis eugenifolia DC.; Apocynaceæ; alk.; Ber., 1890, 3542.

Ligustrum robustum Blume.; Oleaceæ; alk.; Meded. Lands. Plantent, 1899, 132.

Lilium giganteum Wall.; Liliaceæ; leaves—applied to wounds and bruises.

Limnanthemum cristatum Griseb.; Gentianaceæ; used in fever and jaundice.

L. nymphæoides Link.; Gentianaceæ; (P.-Kuru); fresh leaves—in periodic headache.

Limnophila gratioloides Br., Scrophularineæ; (S.-Ambuja, H.-Kuttra, B.-Karpur, Bo.-Ambuli); antisep., carmin., used in fever, liniment in elephantiasis; essen. oil; Phil. Jr. Sci., 1911, 345; Schim. Ber. 1912, April 83.

L. gratissima Blume.; vern. same as L. GRATIOLOIDES; galact.

Limonia acidissima Linn.; Rutaceæ; (H.-Beli, Bo.-Ram limbu); leaves—purg., sudorific, used in snake-bite, dried fruit diminishes intestinal fermentation.

Linaria cirrhosa H. K.; Scrophularineæ; in diabetes; Murray, Drugs of Sind.

L. cymbalaria; in diabetes; Prain, Beng. Plants.

L. minor Desf.; HCN in young branches; Pharm. Act. Helvet., 1926, 167.

L. ramosissima Wall.; used in diabetes.

Lindenbergia urticæfolia, Lehm.; Scrophularineæ; (Bo.-Dhol); in chr. broncht. and skin eruptions.

Lindera neesiana Benth.; Laurineæ; arom., carmin., yields excellent sassafras.

Linum usitatissimum Linn.; Lineæ; (S.-Atasi, H. & B.-Tisi, Bo.-Alasi, M.-Alshiviral); as poultice, internally in bronchial affections and diar.; seeds—HCN-glucd. linamarin; C. C. 1907. I. 1440; 0,0812 mg. arsenic oxide in 1 kg. seeds; Pharm. Weekbl., 1921, 1482 (C. C. 1922. II. 113).

Liparis parviflora Lindl.; Orchidaceæ: alk.
Lippia nodiflora Rich.; Verbenaceæ; (S.-Vashira, H.-Bukkan, B.-Bhui-okra, Bo.-Ratolia, M.-Podutalai); febge., diur.
Liquidambar orientalis Miller; Hamamelideæ; (S.-Silhaka, H., B. & Bo.-Silaras, M.-Meri-arishippal); expect., in scorpion-sting; Ber. 1890, 155; Arch. Pharm. 1901, 506; Chem. & Drug. 1912, 412.
Lithospermum officinale Linn.; Boragineæ; (H.-Lubis firmun); remedy for stones; Arch. Pharm. 1858, 278.
Litsæa citrata Bl.; Laurineæ; alk. laurotetanine; tox.; Bull. Jard. Bot. Buitengorg, 1921, 180.
L. polyantha Juss.; (H.-Meda, B.-Bara-kukur-chita, Bo.-Ranamba, M.-Nara); bark—astrin., stomch., stim.; Pharm. Jr. 1913, 369.
L. sebifera Pers. (H.-garbijaur, B.-Kukurchita, Bo.-Maidá-lakadi, M.-Maida lakti); demulc., emol., diar., dysen. and scorpion-sting; alk. laurotetanine; Pharm. Ind. Vol. III, 212; Prakt. Chem. 1867, 424.†
L. stocksii Hook. (Bo.-Pisi); in irritation of bladder and urethra, oil—in sprains and bruises; essen. oil, alk.; Pharm. Ind. Vol. III, 213.
About sixty species of Litsæa are uninvestigated.
Lobelia nicotianæfolia Heyne; Campanulaceæ; (Bo.-Dhavala, M.-Kattu papillay); antisp., in asthma, scorpion-sting; alk. lobeline; Pharm. Z. Russl. 1886, 353.
About fifteen species uninvestigated.
Lodoicea sechellarum Comm. & Labill.; Palmæ; (S.-Ubdie-narikaylum, H. & Bo.-Darya-ka-Nariyal M.-Kadat-rengay); tonic, preservative, alexipharmic.
Lolium temulentum Linn.; Gramineæ; (H.-Machni); cattle poison; tox. alk. temuline; Arch. Exper. Path. Pharm. 1892, 203; glucd.; Compt. Rend., 1902, 134, 1173; 1903, 136, 1013.†
Lonicera glauca Hk. f. & T.; Caprifoliaceæ; (P.-Shewa); seeds given to horses for colic.
Lophopetalum wallichii Kurz.; Celastrineæ; (Burm.-Mondaing) febge.
Loranthus elasticus Desr.; Loranthaceæ; (M.-Maviwitthil); leaves—used to check abortion, also in stone in bladder and kidney affections.
L. falcatus Linn.; narcotic, subst. for betel-nut.
L. longiflorus Desr.; Loranthaceæ; (M.-Plavithil); bark—used in wounds and menstrual troubles and also as a remedy in consumption, mania and asthma.
Lotus corniculatus Linn.; Leguminosæ; HCN.-glucd.; Chem. News, 1911, 276; Pharm. Jr., 1911, 881.
Luffa acutangula Roxb.; Cucurbitaceæ; (S.-Koshátaki, H. & Bo.- Torai, B.-Jhinge, M.-Pikunkai); emetic, purg., bitter tonic, diur.; bitter substance luffin; Pharm. Jr. 1890, 997; Jr. Soc. Chem. Ind. 1898, 991; 1910, 1428.
L. ægyptiaca Mill. (S.-Rajkoshátaki, H.-Ghia-tarui, B.-Dhundul, Bo.-Ghosáli, M.-Guttibira); seeds—emetic, cath.; saponin; Ber., Pharm. Ges. 1904, 175 & 180.
L. amara Roxb.; use same as L. ACUTANGULA.
L. echinata Roxb. (S.-Koshátaki, H.-Kukarlata, B.-Ghosalata, Bo.-Kukar-wele, M.-Panibira); emetic, anthelm., in jaundice, phthisis, hiccough; amorph. bitter substance; Pharm. Jr. 1890, 997.
L. graveolens Roxb. (S.-Brihatphala, Koshátaki); Pharm. Jr. 1890, 997
L. pentandra Roxb.; emetic and cath.; Stewart, Punj. Plants.
Luisia brachystachys Blume; Orchidaceæ; alk.
Lupinus albus Linn.; Leguminosæ; (H.-Turmas, B.-Turmuz); anthelm., diur., pectoral and tonic; alks. lupinine, lupinidine, lupamine; Ber. 1904, 2351; Arch. Pharm. 1892, 61; 1897, 263.

Luvunga scandens Ham.; Rutaceæ; (S.-Lavangalata, B.-Labangaphal); in scorpion-sting.
Luzula campestris DC.; Juncaceæ; diur.
Lycium barbarum Linn.; Solanaceæ; (Baluchi.-Koh-tor); young leaves contain HCN; Pharm. Act. Helvet., 1926, 167.
L. europæum Linn.; (P.Kangu, Bo.-Ganger); aphrodis.
Lycoperdon gemmatum Batsch.; officinal in the Punjab; Stewart, Punj. Plants.
Lycopersicum esculentum Mill., syn. SOLANUM LYCOPERSICUM Linn., Solanaceæ; oxalic acid; Amer. Jr. Pharm., 1872, 197.
Lycopodium clavatum Linn.; Lycopodiaceæ; (M.-Bendarli); diur., demulc., antisp., emmen., used in rheum. and pulmonary disorders.
Lycopus europæus Linn.; Labiatæ; (Kash.-Gandamgundu, Baz.-Jalnim); cooling, used as poultice; bitter substance; Buchn. Repert. Pharm., 1823, 11

Macaranga roxburghii Wight.; Euphorbiaceæ; (Bo.-Chandwar, M.-Vattekanni); gum applied to venereal sores.
Machilus macrantha Nees.; Laurineæ; (M.-Kolamavu); bark—used in consumption, asthma and rheum., leaves—applied to ulcers.
Macrotomia benthami DC.; Boragineæ; (Ind. Baz.—Gaozabán); useful in diseases of tongue and throat.
M. perennis Boiss.; roots—applied to eruptions.
M. speciosa Aitch. et Hemsl.; roots—applied to eruptions.
Mæsa indica Wall.; Myrsineæ; (M.-Kirithi); leaves—used as fish poison.
Mallotus philippinensis Muell.; Euphorbiaceæ; (S.-Rechanaka, H. & B.-Kamala, Bo.-Shendri, M.-Kapila); anthelm.; rottlerin; Ber. 1886, 3109; Arch. Pharm. 1907, 572; J. C. S. 1925, 2044; 1893, 975; 1895, 230; Jr. Ind. C. S. 1928, 21.*
Malva parviflora Linn.; Malvaceæ; (H.-Panirak); seeds—demulc.
M. rotundifolia Linn. (H. & Bo.-Khubazi, M.-Trikálá-malle); used in broncht., piles and ulceration of bladder.
M. sylvestris Linn. (H.-Gul kheir, Bo.-Khubazi); cooling, demulc.; Ann. Chem. 1915, 110; C. C., 1912, 1601.
Mandragora officinarum Linn.; Solanaceæ; (S. & H.-Lakshmana, M.-Kattai-jati); narcotic, anæsthetic, poisonous; pseudo-hyocyamine; Jr. Prakt. Chem., 1901, 274; J. C. S. 1912, 946.†
Mangifera indica Linn.; Anacardiaceæ; (S.-Amva, H., B. & Bo.-Amb, M.-Mam-maram); fruit—laxt., diur., astrin.; bark—used in uterine hæmor., hæmoptysis and melæna,; Chem. Ztg. 1897, 719; Pharm. Jr. 1907, 718; leaves—in scorpion-sting.
Manihot utilissima Pohl.; Euphorbiaceæ; (Baz.-Cassarva, M.-Maravuli); Juice—poisonous; cyanogenetic glucd.; Proc. Roy. Soc. 1906, 152; Jr. Soc. Chem. Ind., 1908, 428; Ber. Pharm. Ges., 1906, 22.
Manisuris granularis Linn.; Gramineæ (S.-Palanggini, H.-Trinpali); used in enlarged spleen and liver.
Maranta arundinacea Linn.; Scitamineæ; (H.-Tikkor, B.-Ararut, Bo.-Tavkil, M.-Kuamau); nutrient and demulc.; Pharm. Jr., 1894, 624; Jr. Soc. Chem. Ind., 1887, 334.
Marlea tomentosa Endl.; Cornaceæ; (B.-Marlea); alk.; Ber. Pharm. Ges., 1899, 214.
Marrubium vulgare Linn.; Labiatæ; (Ind. Baz.—Farashiyun); stim., expect., resolv., anthelm., alter., used in jaundice, ammen., hepatitis; bitter substance, essen. oil; Arch. Pharm., 1861, 257; Jr. Amer. C. S. 1908, 265; Amer. Jr. Pharm., 1890, 327; Pharm. Ztg., 1902, 74; Amer. Jr. Pharm. 1897, 201.

Marsdenia roylei Wight.; Asclepiadeæ; (H.-Murkula, P.-Kurang); cooling and alter., in gonor.

M. tinctoria R. Br.; (B.-Rioug, Nep.-Kalilara); alk.; Meded. Lands Plantent, 1899, 138.

Marsilea grandifolia Linn.; Marsileaceæ; acrid, cooling, astrin. and hypnotic; Prain, Beng. Plants.

Martynia diandra Glox.; Pedalineæ; (H.-Bichu, B.-Baghnoki, Bo.-Vinchhu, M.-Garuda-mukku): used in scorpion-sting.

Matricaria chamomilla Linn.; Compositæ; (Bo. & P.-Babuna); diur., stim., carmin.; essen. oil; J. C. S., 1914, 2280, Jr. Amer. C. S. 1915, 157 & 1537; Ber. 1927, 2459.

Matthiola incana R. Br.; Cruciferæ; (P. & B.-Todri-safed); seeds—stim., expect., aphrodis and antid. to poisons.

Meconopsis aculeata Royle.; Papaveraceæ; (Simla.-Kanta); narcotic.

M. nipalensis DC.; root—officinal in Kashmir; narcotic.

M. robusta Hk. f. & T.

M. simplicifolia Hk. f. & T.

M. wallichii Hook.; narcotic.

Melaleuca leucadendron Linn.; Myrtaceæ; (H., B. & Bo.-Kajaputi, M.-Kaiyappudai); stim., antisp., rubft., used in psoriasis, eczema; essen. oil; C. C. 1929, 3044; 1930, 759; J. C. S. 1872, 251; Chem. & Drug. 1910, 832.

Melanorrhœa usitata Wall.; Anacardiaceæ; (Burm.-Thitsi, Manipur.—Khen); anthelm., used in skin diseases; Ind. For. Rec. 1909, 287; C. C. 1914, 1979.

Melastoma malabathricum Linn.; Melastomaceæ (M.-Nakkukaruppan); juice of leaves and root—used in indign.; flowers—nervous sedative, in piles and hæmor.

Melia azadirachta Linn.; Meliaceæ; (S.-Nimba, H., B. & Bo.-Nim, M.-Vembu); used in scorpion-sting and snake-bite, antisep., antiper., anthelm., emmen., tonic, in skin diseases; bitter substance, bitter oil; Jr. Soc. Chem. Ind., 1923, 387; Arch. Pharm., 1910, 171; Analyst 1903, 342; Jr. Ind. C. S., 1931, 773.*

M. azedarach Linn.; (S.-Mohanimba, H.-Mohanimb, B.-Ghoranimb, M.-Malaivembu); leaves—anthelm., diur., used in skin diseases.

M. dubia Cav. (S.-Arangaka, H. & Bo.-Kadukhajur, M.-Mallay vembu); anthelm., used in skin diseases; glucd.; Pharm. Ind., Vol. I, 333.

Melica ciliata Duthie; Gramineæ; HCN; Jr. Pharm. Chim., 1906, 355.

Melilotus alba Lam.; Leguminosæ; astrin., narcotic; coumarin; Pharm. Ind., Vol. I, 405; Ber. 1874, 146; C. C. 1926, 2477.

M. officinalis Willd. (H.-Aspurk, B.-Banpiring); astrin., remedy for swellings and bowel complaints; coumarin, glucd.; Jr. de Pharm., 1825, 481; 1835, 172; Ber. 1920, 2027; 1920, 2069; Apoth. Ztg. 1900, 515.

M. parviflora Desf. (S.-Banamethiká, H. & B.-Ban methi, Bo.-Zir); seeds—in bowel complaints.

Melissa parviflora Benth.; Labiatæ; stomch., used in liver and heart disease and in bites of venomous insect.

Melochia corchorifolia Linn.; Sterculiaceæ; stems and leaves—boiled in oil, remedy for bites of water-snakes.

Melodinus monogynus Roxb.; Apocynaceæ; (B.-Sadul kou); fish poison.

Memecylon amplexicaule Roxb.; Melastomaceæ; (M.-Kaikkathetti); decoct. of flowers and shoots—used in skin diseases; root—ecbolic.

M. angustifolium Wight. (S.-Kakajembu, M.-Attunjarci); bark—tonic and cooling.

M. edule Roxb.; Melastomaceæ; (S.-Anjani, B.-Anjana, M.-Kashamaram); leaves—in conjunctivitis, roots—in menor. and gonor.

Mentha aquatica Linn.; essen. oil; Schim. Ber. 1923, 52; 1926, 71; 1928, 66.

Mentha arvensis Linn.; Labiatæ; (H.-Podina, B. & Bo.-Pudinah, M.-Pudina); antisp., carmin., stim., emmen.; essen. oil; Schim. Ber. 1925, 61; 1926, 96.
M. piperita Linn.
M. sativa Linn.; essen. oil; Schim. Ber. 1921, 85.
M. sylvestris Linn.; essen. oil; Schim. Ber. 1913, April, 70; 1926, 72; Bull. Imp. Inst. Lond. 1913, 432; Jr. Amer. C. S. 1912, 67.
M. viridis Linn. (H.-Paharipudina, B., Bo. & M.-Pudina).
Menyanthes trifoliata Linn.; Gentianaceæ; tonic; resembles Gentian in its properties; glucd. menyanthin, meliatin; Jr. Pharm. Chem. 1910, 165; 1911, 49; 1913, 529; Chem. News. 1912, 25; 1916, 85; Arch Pharm. 1925, 161.†
Meriandra bengalensis Benth.; Labiatæ; (H. & Bo.-Kafur ka pat, M.-Shima-karpuram-àku); tonic, carmin., astrin., antisep.
M. strobilifera Benth.; vern. and properties similar to M. BENGALENSIS.
Mesua ferrea Linn.; Guttiferæ; (S., H. & B.-Nagkeshar, Bo.-Nágchampa, M.-Nagasháp-pu); blossoms—astrin., stomch., bark and root—bitter, arom., sudorific, useful in gastritis and broncht., leaves and flower—in scorpion-sting; essen. oil, two bitter substances; Bull. Inst Bot. Buitenzorg, 1904, 214; Pharm. Jr. 1908, 161; C. C. 1910, 580.
Mezoneurum sumatranum W. A.; Leguminosæ; alk.; Bull. Inst. Bot. Buitenzorg., 1902, 19.
Michelia champaca Linn.; Magnoliaceæ; (S., H. & B.-Champaka, Bo.-Champa, M.-Shampang); febge., emmen., in scorpion-sting, root—bitter, demulc., flowers—stim., carmin., purg.; essen. oil; Phil. Jr. Sci. 1909, 131; 1910, 262; 1911, 333; Jr. Amer. C. S. 1911, 1763.
M. nilagirica Zen. (H.-Pilachampa, M.-Sempagum); febge.; essen. oil and bitter substance; Schim. Ber 1887, Oct. 36; Phil. Jr. Sci. 1911, 333.
Micromeria capitellata Benth.; Labiatæ; arom., carmin.
Microrhynchus nudicaulis Less.; Compositæ; Stewart, Punj. Plants.
Millettia atropurpurea Benth.; Leguminosæ; fish poison; saponin, glucd.; Ber. 1890, 3538; Pharm. Centralh 1892, 742.
M. pachycarpa Benth.; fish poison; saponin; ref. same as M. ATROPURPUREA.
Mimosa lucida Roxb.; Leguminosæ; (H. & Bo.-Kachora); used in leprosy, stimulates growth of hair.
M. pudica Linn. (S.-Váráha krántá, H. & B.-Lajálu, B.-Lájak, M.-Total-vadi); juice—antisep., alter., blood purifier, used in piles and scorpion-sting.
M. rubicaulis Lam. (H. & B.-Shiah-kanta, Bo.-Huziru, M.-Bida); used in piles.
M. suma Roxb. (S.-Samee, B.-Saingach, Bo.-Sami); bitter, astrin., refrig, used in leprosy, piles, cough, diar.
Mimusops elengi Linn.; Sapotaceæ; (S., H. & B.-Bakul, Bo.-Borsali, M.-Magadam); bark—astrin., tonic, decoct.—as gargle, fruit—in snake-bite; saponin; Jr. Soc. Chem. Ind., 1910, 1430; C. C. 1930, 2895.
M. hexandra Roxb. (S.-Rajadani, H.-Khirni, B.-Khirkhe jur, Bo.-Rajan, M.-Palla); demulc., emol., tonic, alter.; Jr. Ind. Inst. Sci. 1924, 71; Compt. Rend. 1888, 1625.
M. kauki Linn. (H. & Bo.-Khirni); tonic, febge., anthelm., used in ophthalmia and infantile diar.; Meded. Lands Plantent Buitenzong, 1902, 96.
Mirabilis jalapa Linn.; Nyctagineæ; (S. & B.-Krishnakeli, H. & Bo.-Gulabbás, M.-Pattaráshu); purg.; alk, trigonelline; Z. Physiol. Chem., 1912, 290; 1913, 270.†
Modecca palmata Lam.; Passifloreæ; (Bo.-Undal); poisonous.

Modecca wightiana Wall.
Molinia cœrulea Mœnch.; Gramineæ; Pb, depends on the soil; Monatsh. Chem., 1890, 19.
Mollugo cerviana Ser.; Ficoideæ; (B.-Gimáság, Bo.-Pada, M.-Parpadagum); febge.
M. hirta Thunb. (P. & Bo.-Gandibuti, M--Sirooseroo-padi); applied to itches and skin diseases.
M. spergula Linn. (S.-Grishma-sundaraka, H. & B.-Jima, M.-Tooraellay); stomch., aper., antisep., used in skin diseases.
M. stricta Linn. (Bo.-Zharas, M.-Verrichá-tarási); stomch., aper., antisep., emmen.
Momordica balsamina Linn.; Cucurbitaceæ; (Bo.-Kurelo-jangro); used in healing wounds; Ber. Botan. Ges. 1910, 365.
M. charantia Linn. (S.-Sushavi, (H.-Karélá, B.-Karalá, Bo.-Kárlá, M.-Pávakkáchedi); emetic, purg., used in snake-bite; Ber. 1904, 308; Arch. Pharm. 1863, 111; Apoth. Ztg. 1929, 1480.†
M. cochinchinensis Spreng. (S.-Karkataka, H. & B.-Kákrol, M.-Adavikákara); stomch., stim., given in cough.
M. cymbalaria Fenzl. (Bo.-Kadavanchi); abortif.; Pharm. Ind., II, 76.
M. dioica Roxb. (S.-Vahisa, H.-Golkankra, Bo.-Kurtoli, M.-Palupaghelkalung); used in piles, scorpion-sting, juice of root—antisep.; Pharm. Ind., Vol. II, 76.
M. umbellata Roxb. see ZEHNERIA UMBELLATA.
Monochoria hastæfolia Presl.; Pontederiaceæ; (S.-Neelotpalam, M.-Karink-uvalam); alter., tonic, cooling, also used in insanity, juice of leaves—in boils.
Morchella esculenta Pers.; (P.-Kana kach); aphrodis., narcotic.
Morina persica Linn.; Dipsaceæ; (H.-Bekh-akhwar).
Morinda citrifolia Linn.; Rubiaceæ; (H. & B.-Ach, Bo.-Aal, M.-Minamaram); tonic, febge., emmen., used in diar. and dysen.; glucd. morindin; Arch. Pharm. 1907, 534 & 281; J. C. S 1887, 87; 1920, 561; 1918, 766.
M. concanensis Nimmo. (Bo.-Motvah); subst. for horse-radish.
M. tinctoria Roxb. (S.-Achuka, H.-Achi, B.-Ach, M.-Tunaon); root—astrin.
M. umbellata Linn. (Bo.-Al, M.-Nuna); in diar.; glucd.; J. C. S., 1893, 1160; 1864, 851.
Moringa pterygosperma Gærtn.; Moringeæ; (S.-Sobhanjana, H.-Sajnah, B.-Sojna, Bo.-Sujna, M.-Murungai); used in ascites, rheum. and in venomous bites, cardiac and circulatory tonic, antisp.; alk., gum.; Compt. Rend., 1900, 733; 1908, 647; Arch. Pharm., 1906, 159; Analyst, 1903, 342; I. M. G., 1932, March.* †
Morus alba Linn.; Urticaceæ; (S.-Tula, H. & Bo.-Tut); bark—purg., anthelm.; Arch. Pharm. 1917, 187; C. C. 1926, II, 45.
M. indica Linn. (S.-Shálmali, H., B. & Bo.-Tut, M.-Kambili-puch); bark—anthelm., purg.
Mucuna capitata DC.; Leguminosæ; alk.; Pharm. Weekbl., 1906, 202; 1909, 881; Pharm. Jr., 9, 913.
M. gigantea DC.; (Malay.-Kaku-valli); used in rheum.
M. monosperma DC. (Bo.-Sonogaravi, M.-Thelu-kodi); expect., sedative.
M. pruriens DC. (S.-Atmagupta, H.-Kiwach, B.-Alkushi, Bo.-Kuhili, M.-Punaik-kali); seeds—aphrodis., anthelm., nervine tonic in scorpion-sting; C. C. 1923, I, 1372; 1921, I, 456.
Mukia scabrella Arn.; Cucurbitaceæ; (S.-Ahilaykhan, H.-Agamaki, Bo.-Chiráti, M.-Musu-musukkai); diur., stomch.
Mundulea suberosa Benth.; Leguminosæ; fish poison.

Murraya exotica Linn.; Rutaceæ; (H.-Marchula, B.-Kamini, Bo.-Chula-juti, M.-Naga golunga); refrig., used in rheum., cough, hysteria; glucd. murrayin; Ber. 1876, 690; Pharm. Weekbl. 1908, 1325; Jr. Proc. R. Soc. N. S. Wales 1926, 146.

M. kœnigii Spreng. (S.-Sourabhi-nimba, H.-Katnim, B.-Barsunga, Bo.-Karrinim, M.-Karu veppilai); tonic, stomch., used in snake-bite; essen. oil, glucd. kœnigin; Jr. Proc. R. Soc. N. S. Wales, 1926, 146.

Musa paradisiaca Linn.; Scitamineæ; (S.-Kadali, H. & Bo.-Kela, B.-Kala); root—anthelm., flowers ('mocha')—astrin., juice of stem.—in otalgia and hæmoptysis; Jr. Amer. C. S. 1912, 1706; C C. 1921, IV, 137; Compt. Rend, 1912, 893; Apoth. Ztg. 1910, 440.

M. sapientum Linn. (S.-Rambhá, H. & Bo.-Kela, M.-Vazhaip-pazham); use same as M. PARADISIACA, useful in bite of boa-constrictor.

Mussænda frondosa Linn.; Rubiaceæ; (S.-Sribati, H.-Bedina, Bo.-Bhuta-kesa, M.-Vella-ellay); diur., in cough, asthama, ague, flatulence; saponin; Pharm. Centralbl. 1892, 743.

Myrica nagi Thunb.; Myricaceæ; (S.-Katphala, H., B. & Bo.-Kaiphal, M.-Marudam-pattai); astrin., stim., carmin., antisep., useful in fever, asthma, cough; J. C. S. 1896, 1287; Proc. Chem. Soc. 1902, 11.

Myricaria elegans Royle.; Tamariscineæ; (Pb.-Umbu); applied to bruises.

Myriogyne minuta Less.; used as a snuff.

Myristica fragrans Houtt.; Myristiceæ; (S.-Jatifalam, H., B. & Bo.-Jayphal, M.-Jadikkay); oil—aper., carmin.; Proc. Chem. Soc. 1907, 285; 1908, 197; J. C. S. 1908, 1653. *

M. malabrica Lamk. (Bo.-Ramphal); aphrodis., used in headache and indolent ulcers; essen. oil; Apoth. Ztg. 1886, No. 34; Agri. Ledger, 1907.*

Myropyrum similacifolium Blume.; Oleaceæ; (M.-Chathuramallikei); leaves—used as a remedy in asthma, cough, rheum., nervous complaints.

Myrsine africana Linn.; Myrsineæ; (H.-Chapra); anthelm., laxt.

Myrtus communis Linn.; Myrtaceæ; (H.-Vilayiti Mehndi, B.-Sutr-sowa, Bo.-Abhulas); astrin., stim.; antisep., rubft., in scorpion-sting; essen. oil; Arch. Pharm. 1889, 174; Schim. Ber. 1924, 61; 1929, 65; J. C. S. 1864, 1; 1872, 1; Chem. Ztg. 1905, 1031; 1910, 857.

Nannorhops ritchieana H. Wendl.; Palmæ; (H.-Mazri); leaves—used in dysen., diar.

Narcissus tazetta Linn.; Amaryllidaceæ; (P.-Nargis); root—emetic, used to relieve headache.

Nardostachys jatamansi DC.; Valerianeæ; (S., H. & B.-Jatámánshi, Bo.-Balacharea, M.-Jatámáshi); root—arom., antisp., diur., emmen., nerve sedative, in scorpion-sting, subst. for Valerian; essen. oil; Pharm. Ind. II, 237; Schim. Ber., 1907, Oct., 65; 1926, 75.†

Naregamia alata W. & A.; Meliaceæ; (Bo.-Pittpápra, M.-Nelanaringu); emetic, expect., used in acute dysen.; alk. naregamin; Arch. Pharm., 1888, 36; C. C. 1916, I. 892.

Nasturtium officinale R. Br.; Cruciferæ; (Kumaon.—Piriya halim, Dec.-Lut-putiah); appetisar and antiscor.; glucd., essen. oil, As—0,012 mg. in 100 g. dry plant; Compt. Rend. 1912, 893 (C. C. 1730); Ber., 1899, 2335; Arch. Pharm., 1899, 617; Bull. Soc. Chim., 1896, 797; Lancet, 1928, 97.

Nauclea cadamba Roxb.; Rubiaceæ; see ANTHOCEPHALUS CADAMBA Miq.

N. ovalifolia Roxb. (B.-Shal); used for bowel complaints and fever.

Nelumbium speciosum Willd.; Nymphæaceæ; (S. & Bo.-Kamala, H.-Kanwal, B.-Swet padma, M.-Ambal); flowers—cooling, astrin., cholag. and diur. used in scorpion-sting and cobra-bite; alk. nelumbine; Biol. Centrabl., 1904, 240; Meded. Lands. Plantent, 1899, 125†

Nepeta ciliaris Benth.; Labiatæ; (P. & Bo.-Zufa); used in fever and cough.

N. elliptica Royle.; used in dysen.; Stewart, Punj. Plants.

N. glomerulosa Boiss. (Baluchi.-Chingam butai); used in digestive troubles.

N. ruderalis Ham. (P.-Billi lotan); cardiac tonic, as gargle in sore throat, in gonor.

Nephelium litchi Camb.; Sapindaceæ; (H., B. & Bo.-Lichi); leaves—for bites of animals; U. S. Dept. Agri. Exp. Stat. Bull., 28; Jr. Amer. Chem. Soc., 1918, 817.

N. longana Camb. (B.-Ansh phal, Bo.-Wumb, M.-Puvati); stomch., anthelm.; saponin.; Apoth. Ztg., 1893, 589; Pharm. Jr., 1913, 369.

Neptunia oleracea Lour.; Leguminosæ; H.-Laj-alu, B. & Bo.-Pani lazak, M.-Sunday-kiray); refrig., astrin.

Nerium odorum, Soland.; Apocynaceæ; (S.-Karavi, H.-Karber, B.-Karabi, Bo.-Kanhera, M.-Alari); externally applied to swellings, leprosy and skin diseases, poisonous; glucd.; C. C. 1881, 218; Proc. Chem. Soc., 1901, 92.†

N. tomentosum Roxb. (H. & Bo.-Kala inderjav, B.-Dudhi); used in menstrual and renal complaints and in venomous bite.

Neuracanthus sphærostachyus Dalz.; Acanthaceæ; (Bo.-Ghosuel); in indign. and ringworm.

Nicandra physaloides Gærtn.; Solanaceæ; diur.

Nicotiana rustica Linn.; Solanaceæ; (H. & B.-Vilayeti tamaku, P.-Kakkar tamaku); similar to N. TABACUM; alk. nicotine; Bull. Soc. Chim., 1922, 125; C. C. 1915, II, 233.

N. tabacum Linn. (H.-Tamaku, B.-Tamák, Bo.-Tambaku, M.-Pugai-ilai); sedative, antisp., rheumatic swelling, skin disease, in scorpion-sting; Ba; Jr. Amer. C. S. 1913, 826; oxalic acid; Ber. Pharm. Ges. 1909, 292.

Nigella sativa Linn.; Ranunculaceæ; (S.-Krishnajiraka, H. & B.-Kalajira, Bo.-Kalenjire, M.-Karun-shiragam); carmin., diur., emmen., in scorpion-sting; essen. oil, tox. glucd. melanthin, bitter substances; J. C. S., 1880, 718; Pharm. Jr., 1882, 681; 1884, 863; Arch. Exp. Pathol., 1883, 440; Schim. Ber., 1895, April, 74; 1913, Oct. 97.†

Notonia grandiflora DC.; Compositæ; (Bo.-Wánder-roti); prophylaxis against hydrophobia.

Nyctanthes arbortristis Linn.; Oleaceæ; (S. & B.-Sephalika, H.-Siharu, Bo.-Párijátaka, M.-Manjapu); leaves—in fever and rheum., cholag., laxt., anthelm. and in sciatica, antid. to reptile venoms.

Nymphæ alba Linn.; Nymphæaceæ; (Kash.-Brimposh, Bo.-Pandharen-kamal); demulc., in diar.; alk. nupharine; Arch. Pharm., 1882, 589; Chem. News, 1915, 289 & 203.

N. lotus Linn. (S.-Raktotpal, H.-Chota kanval, B. & Bo.-Raktakamal, M.-Alli-támarai); in dyspep., diar. and piles, cardiac tonic.

N. stellata Willd. (S.-Nilotpal, H.-Krishna kamal, B.-Nil-sápla, Bo.-Uplia-kamal, M.-Nalla-kalava); use similar to N. LOTUS.

Ochrocarpus longifolia Benth & Hook.; Guttiferæ; (S.-Punnag, H. & B.-Nagkeshar, Bo.-Suringi, M.-Nagap-pu); astrin., arom., in scorpion-sting.

Ocimum basilicum Linn.; Labiatæ; (S.-Munjariki, H.-Sabzah, B.-Babui-tulshi, Bo.-Sabza, M.-Tirnut-patchie); carmin., stim., seeds—demulc., root—febge., antid. to snake poison; essen. oil; Jr. Soc. Chem. Ind., 1918, 604; C. C. 1911, I, 223; Schim. Ber. 1903, April, 33; 1925, 54; 1929, 70.†

O. canum Sims. (H. & B.-Kala tulshi, M.-Kukka-tulasi); in skin diseases; Schim. Ber. 1903, April, 33; 1925, 54; 1929, 70.

O. caryophyllatum Roxb. (S.-Marubaka, H.-Golatulshi, B.-Gandha tulshi); stim., stomch., carmin., anthelm., used in skin diseases and scorpion-sting; essen. oil.

O. gratissimum Linn. (S.-Vantulshi, H. & B.-Ramtulshi, Bo.-Ramatulasa, M.-Elumichcham-tulasi); styptic, stim., demulc., carmin., diur.; essen. oil, thymol, eugenol, methyl chavicol; Bull. Imp. Inst., 1918, 38; Jr. Soc. Chem. Ind., 1921, 164; Schim. Ber., 1924, 62.†

O. longiflorum Haml.; see ORTHOSIPHON STAMINEUS Benth.

O. pilosum Willd.; see O. BASILICUM.

O. sanctum Linn. (S. & M.-Tulashi, H., B. & Bo.-Tulshi); leaves—expect., root—febge., seeds—demulc., used in snake-bite and scorpion sting; essen. oil; Schim. Ber., 1911, April, 87; 1912, April, 95.

Odina wodier Roxb.; Anacardiaceæ; (S.-Jingini, H.-Jingan, B.-Jiol, Bo.-Jinyan, M.-Odiya maram); juice applied to sore eyes and obstinate ulcers; Pharm. Jr., 1892, 1073; Arch. Pharm., 1912, 320.

Olax nana Wall.; Olacineæ; (Santh.—Merom met).

O. scandens Roxb. (H.-Dheniani, B.-Koko-aru, Bo.-Harduli, M.-Kurpo-dur.); bark—in anæmia.

Oldenlandia biflora Roxb.; Rubiaceæ; (S. & B.-Khet papra, H.-Daman-papra, M.-Parpadagam); used in remittent fever, gastric irritation and nervous depression; alk.; Pharm. Ind., Vol. II, 199.†

O. diffusa Roxb.; decoct.—used in biliousness, impure blood, fever and gonor.

O. heynei Hk. f. (M.-Nonganam-pillu); specific for snake-bite, leaves—used in asthma, rheum., and fever.

O. umbellata Linn.; (H.-Chirval, B.-Surbuli, M.-Saya); expect., febge. used in snake-bite; alizarin; Proc. Chem. Soc., 1907, 288; J. C. S., 1893, 1160.

Olea cuspidata Wall.; Oleaceæ; (H.-Kau, Bo.-Khau); oil from fruit—rubft., leaves and bark—astrin., antiper.

O. dioica Roxb. (B.-Attajam, Bo.-Parjamb, M.-Koli); bark—febge.

O. glandulifera Wall. (P.-Gulili); astrin., antiper.; glucd.; Pharm. Ind., II, 379; Meded. Lands Plantent 1897, 29; 1899, 132.

Onosma bracteatum Wall.; Boragineæ; (H., B. & M.-Gaozaban); tonic, alter., used in rheum., syphilis, leprosy.

O. echioides Linn. (H.-Ratanjot); leaves—alter., flowers—stim., in rheum. and palpitation of heart.

O. hookeri Clarke.; for colouring medicinal oil.

Ophelia angustifolia Don.; Gentianaceæ, see SWERTIA ANGUSTIFOLIA.

O. chirata; see SWERTIA CHIRATA.

O. multiflora Dalz. see SWERTIA DECUSSATA.

Ophiorrhiza mungos Linn.; Rubiaceæ; (S.-Sárpákshi, H.-Sarahati, B.-Gandhanákuli, M.-Kiri-purandan); bitter tonic used in snake-bite and scorpion-sting.

Opopanax chironium Koch.; Umbelliferæ, (H. & Bo.-Juvashur, B.-Jawe-shi); gum resin—stim., antisp.; essen. oil; Perfeum Moderne, 1921, 82.

Opuntia dillenii Haw.; Cacteæ, (S.-Vidara, H. & B.-Nágphaná, Bo.-Samar, M.-Nága dali); fruit—in whooping cough, asthma, as cholag. and in snake-bite; Jr. Ind. Inst. Sci., 1923, 173.†

Orchis latifolia Linn.; Orchideæ; (H.-Salap); use similar to O. LAXIFLORA; glucd.; Jr. Pharm. Chim., 1914, 542; Compt. Rend., 1920, 435; 1925, 224.

O. laxiflora Lam. (H. & B.-Salap mistri, M.-Shala-misiri); tuber—expect., astrin., nutri.

O. mascula Linn. (B.-Salep misri, Bo.-Salum); use similar to O. LAXIFLORA; glucd. bitter substance; Chem. News, 1915, 295; Ann. Chim., 31.349.†

Origanum majorana Linn.; Labiatæ; (S.-Marva, B.-Murru, Bo.-Murwo, M.-Marrau); use similar to mint; essen. oil, bitter substance; Schim. Ber. 1926, 70; 1918, 34; Ber. 1907, 596.

O. vulgare Linn. (H.-Sáthra, H.-Mridu-maru-vama); essen oil—arom., stim., tonic, in diar.; used in rheum., toothache and earache; Arch. Pharm., 1880, 277; Schim. Ber., 1923, 56.

Ormocarpum sennoides D C.; Leguminosæ; (M.-Kat morungi); root—tonic, stim., used in paralysis and lumbago.

Oroxylum indicum Vent.; Bignoniaceæ; (S.-Syonáka, H.-Arlu, B.-Sona, Bo.-Tetu, M.-Vanga); bark—astrin., tonic, sudorific, stem—in scorpion-sting; cryst. bitter oroxylin; alk.; J. C. S., 1901, 354; glucd. bitter substance; Dragendorff, Heilpflanzen, 609; Proc. Chem. Soc., 1901, 148.†

Orthosiphon stamineus Benth.; Labiatæ; leaves—in kidney diseases; glucd. orthosiphonin, essen. oil; Amer. Jr. Pharm., 1887, 80; C. C. 1926, II, 1986.

Oryza sativa Linn.; Gramineæ; (S.-Dhanya, H. & B.-Dhan, Bo.-Tandula M.-Arishi); rice gruel—in inflam., stomch., rice poultice—used like linseed meal poultice; Jr. Amer. C. S., 1903, 948; J. C. S., 1923, 2666; alk. oridine (antineuritic when impure) Biochem. Ztscher. 1920, 218; As—7 mg. in 100g. ash of corn; Compt. Rend. 1912, 893; 1914, 269 (C. C. 1912, I. 1730; 1914, II. 885); Jr. Physiol., 1912, 75, 395; Biochem. Jr., 1914, 598; C. C. 1923, I, 1192; 1920, III, 14; 1927, I, 1850.

Osbeckia cupularis Don.; Melastomaceæ; (M.-Chirkualathi); whole plant pounded and applied to swellings.

Osyris arborea Wall.; Santalaceæ; (Nep.-Jhuri, Bo.-Popli); leaves—emetic.

Otostegia limbata Benth.; Labiatæ; (P.-Bui); leaves—applied to gums and in ophthalmia.

Ougeinia dalbergioides Benth.; Leguminosæ; (S.-Tinisa-segandun H.-Sandan, B.-Tinis, Bo.-Tiwas, M.-Tella-motuku); febge., in diar., dysen.

Oxalis acetosella Linn.; Geraniaceæ; refrig., antiscor.; oxalic acid; Pharm. Jr., 1927, 105.

O. corniculata Linn. (S.-Amlika, H. & B.-Amrul, Bo.-Ambuti, M.-Palia kiri); cooling, refrig., stomch., antiscor.; acid potassium oxalate.

Oxyria digyna Hill.; Polygonaceæ; (P.-Amlu); cooling

Oxystelma esculentum Br.; Asclepiadeæ; (S.-Dughdika, H. & B.-Dudhialata Bo.-Dudhiká, M.-Dudipalla); gargle in sore throat, used in jaundice.

Pæderia fœtida Linn.; Rubiaceæ; (S.-Prosárani, H.-Gandhali, B.-Gandha vaduli, Bo.-Hiranvel, M.-Savirela); emol., carmin., used in rheum.; indole., essen. oil, alk.; Pharm. Ind., Vol. II, 229.†

Pæonia emodi Wall.; Ranunculaceæ; (H.-Udsálap, P.-Mamekh); used in colic, bilious obstructions, seeds—emetic, cath.

Pæonia officinalis Linn. (H.-Ud-salap, Bo.-Ude-salam); used in epilepsy; glucd.; Jr. Pharm. Chim., 1911, 238; essen. oil; Ber. 1886. 1776. Ann. Chem. 1915, 1; J. C. S. 1926, 1968.

Panax fruticosum Linn.; Araliaceæ; febge., astrin.; saponin.

Pandanus odoratissimus Willd.; Pandaneæ; (S.-Ketaki, H.-Keorá, B.-Keyá Bo.-Keur, M.-Talum); bitter, purg., arom., used in leprosy; essen. oil; Pharm. Jr. 1880, 653.

Panderia pilosa Hk. f. & T.

Panicum antidotale Retz.; Gramineæ; (H.-Gunara, P.-Ghamur); in throat affections; smoke—to fumigate wounds.

P. crus-corvi Linn.; (H.-Sanwak, B.-Bura shama); used in spleen and to check hæmor.

P. italicum Linn. (S.-Shyamaka, H.-Kangui, B.-Syamdhan); remedy for after-pain; toxic glucd., oily alk.; Amer. Chem. Jr., 1899, 861.

Papaver argemone. Papaveraceæ; see ARGEMONE MEXICANA.

P. dubium Linn.—use similar to P. RHŒAS.

P. hybridum Linn.: alk.

P. nudicaule Linn.; leaves—HCN-glucd.; Compt. Rend., 1913, 727.

P. orientale Linn.; alks. morphine, narcotine, thebaine, iso thebaine; C. C. 1913, II, 2046; Arch. Pharm. 1914, 211.

P. rhœas Linn.; (S.-Rakta-posta, H.-Lalpost, Bo.-Janglimudrika, M.-Shivappu-postaká chedi); slightly sedative; rhœadine, morphine, paramorphine, narcotine; Arch. Pharm., 1890, 7; C. C. 1916, 1159; Chem. News 1916, 85.

P. somniferum Linn. (S.-Ahiphena, H. & B.-Afim, Bo.-Aphu, M.-Posta-katol); narcotic, in diabetes and antid. to snake-poison and scorpion-sting; sap contain oxalic acid; Schweiz. Apoth. Ztg. 1918, 55.*

Paramignya longispina Hook.; Rutaceæ; (B.-Bon-nimbu); fruit—used in colic.

P. monophylla Wight.; (Bo.-Kariwageti); alter., diur., root—given to cattle in hæmaturia.

Pardanthus chinensis Ker.; Irideæ; aper., resolv., used in cobra-bite.

Parmelia kamtschadalis Esch.; Lichenes; vern. and use same as P. PARLATA.

P. perlata Esch. (S.-Silavalka, H.-Charerla, M.-Kalpasi); used in dyspep., amenor., calculi, in scorpion-sting and snake-bite.

Parsonsia spiralis Wall.; Apocyanaceæ: (M.-Pe-nalivalli); juice of the plant—given internally in insanity.

Paspalum scrobiculatum Linn.; Gramineæ; (S.-Kodrava, H.-Kodo, B.-Kodoá dhân, Bo.-Kodra, M.-Kiraruga); used in scorpion-sting.

Passiflora fœtida Linn.; Passifloreæ; (S.-Mukkopeera, M.-Mupparisavalli); decoct. used in biliousness and asthma; fruit—emetic; leaves—applied on the head in giddiness and headache; HCN; Pharm. Weekbl., 1911, 307; Bull. Sc. Pharm., 1906, 603.

Pavetta indica Linn.; Rubiaceæ; (S.-Páppana, H.-Pápari, B.-Kukurchura, Bo.-Papat, M.-Pavut-tay-vayr); aper., used in drospy; glucd., Pharm-Ind. Vol. II, 212.

Pavonia odorata Willd.; Malvaceæ; (S.-Harivera, H.-Sugandha bala, B.-Bola, Bo.-Kálá válá, M.-Peràmutiver); root—astrin., tonic, cooling, demucl., carmin.

P. zeylanica Cav.; (M.-chittamutti); use similar to P. ODORATA

Pedalium murex Linn.; Pedalineæ; (H. & B.-Bara gokhru, Bo.-Mothe-gokhru, M.-Peru-nerunji); for nocturnal emission, impotency; mucil., alk.; Pharm. Ind. Vol. III, 36.

Pedicularis comosa Linn.; Scrophularineæ; glucd. rhinanthin; Compt. Rend., 1907, 439.

P. pectinata Wall.; (H.-Mishram); astrin., hæmostatic.

P. siphonantha Don.; officinal in the Punjab.

Peganum harmala Linn.; Rutaceæ; (H. & Bo.-Harmal, B.-Isband, M.-Shimai-azha-vanai-virai); antiper., alter., stim., emmen., abortif.; alk.; harmine, harmaline; Ber., 1885, 400; 1889, 637; 1897, 2481; J. C. S., 1919, 953.

Pentapetes phœnicea Linn.; Sterculiaceæ; (S.-Bandhuka, H.-Dopahariya, B.-Bándhuli, Bo.-Tambri-dupári, M.-Nága-pu); demulc., used in snake-bite.

Pentatropis microphylla W. & A.; Asclepiadeæ; (M.-Parparam); cooling, alter.

P. spiralis Dcne. (P.-Bonveri, Bo.-Singarota); astrin.

Pericamphylus incanus Miers.; Menispermaceæ; (H. & B.-Barak-kánta); root—antid. to snake poisons; narcotic alk.; Bull. Pharm. 1892, 123.

Periploca aphylla Dcne.; Asclepiadeæ; (P.-Barri, Bo.-Buraye); milky juice—in swellings.

Peristrophe bicalyculata Nees.; Acanthaceæ; (H.-Atrilal, B.-Nasabhaga, Bo.-Pitpápra, M.-Chebira); antid. to snake poison.

Perowskia abrotanoides Karel.; Labiatæ; (Pushtu.-Shanshobai); cooling.

Petroselinum sativum Hoff.; Umbelliferæ; diur., used in amenor., dysmen.; glucd. appin, essen. oil, alk.; Ber., 1876, 259, 1121 and 1477; 1903, 3451; 1907, 3771; 1908, 2753; J. C. S., 1900, 420, 1897, 807; Bull. Soc. Chim., 1907, 1001; Schim. Ber. 1900, Oct. 50; Jr. Soc. Chem. Ind.; 1927, 174.†

Peucedanum grande Clarke.; Umbelliferæ; (H.-Duku, Bo.-Báphali); carmin., stim., diur.; essen. oil; Schim. Ber., 1891, April, 50; Pharm. Ind., Vol. II, 126.

P. graveolens Benth. (S.-Shatapuspi, H.-Soya, B.-Soolpha, Bo.-Balunt-shep, M.-Satakuppi); carmin., diur., emmen.; essen. oil; Pharm. Ind., Vol. II, 129; C. C. 1926, II, 2123; Analyst 1928, 209; Schim. Ber. 1897, April, 13; 1927, 25; Bull. Imp. Inst. Lond. 1927, 118.*†

Phalænopsis amabilis Lindl. Orchidaceæ; alk.; Meded. Lands Plantent, 1899, 123; Pharm. Weekbl., 1921, 1438.

Phalaris canariensis Linn.; Gramineæ; fruits—oxalic acid; C. C., 1916, 1056.

Pharbitis nil Chois.; Convolvulanceæ; subst. for jalap.; Murray, Drugs of Sind.

Phaseolus aconitifolius Jacq.; Leguminosæ; (S.-Makushtaka, H.-Mat, B.-Banmuga, Bo.-Math, M.-Tulka-pyre); root—narcotic, seeds—aphrodis., digest.

P. adenanthus. (S.-Aranyamudga, M.-Kattupayrn); decoct. used in bowel complaints and stricture.

P. lunatus Linn.; seeds—HCN-glucd.; Compt. Rend. 1906, 545 (C. C. 1906, I. 1273); this species sometimes exhibits markedly poisonous properties.

P. mungo Linn. (S.-Mudga, H., B. & Bo.-Mung, M.-Puchapayaru); in scorpion-sting; Compt. Rend. 1930, 934; Arch. Pharm. 1906, 67.

P. radiatus. (S.-Másha, H.-Urid, B.-Mashkalai, Bo.-Udid, M.-Patchay-pyre); lactag., used as poultice in gastritis, dysen., rheum., root—narcotic; Jr. Amer. Chem. Soc. 1897, 509; Jr. Biol. Chem. 1922, 103.

P. roxburghii (M.-Ulunnu); root—narcotic and a remedy for aching bones.

P. trilobus Ait. (S.-Mudgaparni, H. & B.-Mugáni Bo.-Mukuya, M.-Pani-pyre); leaves—tonic, sedative, fruit—in scorpion-sting.

P. vulgaris Linn. (H.-Bakla, P.-Babri, M.-Barigalu); emol.; Compt. Rend., 1926, 1114, Jr. Soc. Chem. Ind. 1920, 246; Chem. Ztg. 1916, 147.

Phelipæa calotropides Walp.; Orobanchaceæ; in sores; Stewart, Punj. Plants.

Phlogacanthus thyrsiflorus Nees.; Acanthaceæ; (B.-Bakah tita, P.-Lal-bahuk); used like ADHATODA VASIKA.
Phœnix dactylifera Linn.; Palmæ; (H. B. & Bo.-Khajur, M.-Perich-chankay); demulc., expect., laxt., aphrodis., in asthma.
P. farinifera Roxb. (H.-Palawat, M.-Kasangu); fresh juice—cooling, laxt.; gum—used in diar., genito-urinary diseases.
P. sylvestris Roxb. (S.-Kharjura, H., B. & Bo.-Kha-jur, M.-Peria-itcham.); tonic and restor.
Photinia serratula Lindl.; Rosaceæ; leaves—HCN-glucd.; Compt. Rend., 1906, 451 (C. C. 1906. II. 1653).
Phyllanthus distichus Muell.; Euphorbiaceæ; (S.-Lavani, H.-Harfarauri, B.-Noari, M.-Arunelli); fruit—astrin., root—purg., seed—cath., leaves and roots used as antid. to viper-venom; saponin; Pharm. Weekbl., 1908, 1156.
P. emblica Linn. (S.-Dhatriphala, H.-Aoula, B.-Amlaki, Bo.-Amla M.-Nelli-kai); in scorpion-sting, fruit—refrig., diur., astrin., stomch., laxt.†
P. maderaspatensis Linn. (H.-Kanocha, M.-Nala userekee); mucilaginous properties.
P. multiflorus Willd. (H & B.-Panjooli); root bark—alter., used in vesical affections.
P. niruri Linn. (S.-Bhumya-ámalaki, H.-Jar-ámla, B.-Bhui-ámlá, Bo.-Bhui-ávála, M.-Kizhkay-nelli); used in sores, chr. dysen., dropsy, menor.; bitter substance, phyllanthin. Ber. Pharm. Ges. 1905, 186.
P. reticulatus Poir. (S.-Krishna kámboji, H.-Panjoli, B.-Pankushi, Bo.-Pavana, M.-Pulavayr puttay); diur., alter., used in bleeding gums.
P. rhamnoides Roxb. (S.-Aruni, H.-Surasaruni); dried leaves—smoked in tonsilitis.
P. simplex Retz. (Bo.-Bhuiavali, M.-Ushchi usirika); useful in itch, abscess, in gonor. and as poultice.
P. urinaria Linn. (S.-Tamara valli, H. & B.-Hazarmani, M.-shivappu-nelli); diur., astrin., cooling, decoct—in jaundice, gonor.
Physalis alkekengi Linn.; Solanaceæ; (S.-Rajaputrika, Ind. Baz.—Kak-naj); diur., alter., anthelm., used in urinary and skin diseases; bitter substance, alk.; Jr. Pract. Chem. 1852, 323; Amer. Drugg. 1886, 961.
P. flexuosa Linn. see WITHANIA SOMNIFERA Dun.
P. minima Linn. (S.-Tankari, H.-Tulatipati, B.-Bantepari); tonic, diur., aper., used in snake poison and scorpion-sting.
P. peruviana Linn.; juice of leaves—given in worms and bowel complaints.
Physochlaina præalta *Hook.; Solanaceæ; (P.-Nandru); leaves—applied* to boils, poisonous.
Phytolacca acinosa Roxb.; Phytolaccaceæ; (H.-Matazor); narcotic; bitter tox. substance phytolacca toxin; Jr. Pharm. Soc. Japan, 1891, Nr., 98; Ber. 1891, 698; C. C., 1928, I, 1820.
Picrasma javanica Blume.; Simarubeæ; bark—febge.; bitter substance.
P. nephalensis Benn.
P. quassioides Benn.; (H.-charangi, B.-Bhurungi); subst. for Quassia, bitter principle quassiin; Pharm. Jr. 1889, 43; 1895, 454.*†
Picrorhiza kurrooa, Benth.; Scrophularineæ; (S.-Katuká, H. & B.-Katki, Bo.-Kàlikutki, M.-Katuka-rogani); cath., stomch., bitter, in scorpion-sting; glucd. picrorhizin; Pharm. Ind. III, 12.*
Pimpinella anisum Linn.; Umbelliferæ; (S.-Shetapuspa, H.-Saonf, B.-Muhuri, Bo.-Sonf, M.-Shombu): diur., used to prevent flatulence and colic; Schim. Ber., 1895, Oct. 6; Bull. Imp. Inst., 1917, 300; Compt. Rend. 1896, 198.*†
P. heyneana Wall. (C. P.-Tiri); root—used in fever.

Pimpinella saxifraga Linn.; essen. oil, bitter substance, saponin; Schim. Ber., 1890, April, 37.

Sixteen species of Pimpinella are uninvestigated.

Pinus deodara Roxb.; Coniferæ; (S. & B.-Devadaru, H.-Deodar, P.-Pahari-keli); wood—carmin., Bark—astrin., febge.; oleoresin; Schim. Ber., 1915, April, 54; J. C. S. 1916, 791; Ind. For Rec. 1922, 111; Jr. Soc. Chem. Ind. 1923, 29.

P. gerardiana Wall. (H.-Rhi); stim., used in rheum; essen oil; Jr. Ind. Chem. Soc. 1928, 63; Ind. For. Rec. 1923, 341.

P. khasya Royle.; (Khasia—Dingsa); essen oil; Jr. Amer. C. S., 1894, 844.

P. longifolia Roxb. (S.-Sarala, H.-Chir); essen. oil; rubft., carmin., used in snake-bite and scorpion-sting; J. C. S., 1920, 570; Jr. Ind. Chem. Soc., 1927, 258*

P. merkusii Jungh. (Burm.-Tinyri); used as other Pines.

P. webbiana Wall. see ABIES WEBBIANA.

Piper aurantiacum Wall.; Piperaceæ; (S.-Renuka, H.-Shambhaluka buj, B.-Renuk); bitter, acrid, refrig.

P. betle Linn. (S.-tambula, H., B. & Bo.-Pán, M.-Vettilai); arom., carmin., stim., astrin., given internally in snake-bite; essen. oil, chavicol; Ber. 1889, 2736; Schim. Ber., 1914, April 30; 1917, 10.*†

P. chaba Hunter. (S.-Chavika, H.-Chab, B.-Chai, Bo.Kankala); fruit—arom., stim., carmin., used in cough and cold.

P. cubeba Linn. (S.-Sugandha muricha, H., B. & Bo.-Kabab-chini, M.-Val milaku); used in cystitis, gonor.; essen. oil, cubebin; Jr. Soc. Chem. Ind. 1928, 792; Jr. Amer. C. S. 1915. 1537; Schim. Ber. 1922, 20.*

P. longum Linn.; (S.-Pippali, H.-Pipal, B.-Pipul, Bo.-Pipli, M. Pippallu); used in cough and cold, antid. to snake-bite and scorpion-sting.

P. nigrum Linn. (S.-Maricha, H.-Golmirch, B.-Golmarich, Bo.- Kala miri, M.-Milagu); carmin., stim., in scorpion-sting; alk. pipirine, piperidine, essen. oil, Ber. 107, 3776; Amer. Jr. Pharm. 1908, 1; Schim. Ber. 1890, Oct. 39.

P. sylvaticum Roxb. (B.-Pahari-pipul); carmin.; roots—antid. to snake poison.

About thirty-five species of Piper are uninvestigated.

Pisonia aculeata Linn.; Nyctagineæ; (B.-Baghachura, M.-Embudi-chettu); counter irrit. for swellings and rheum.

P. alba Spanoghe (Bo.-Chinaisalit); used in inflam. of elephantoid nature.

Pistacia integerrima Stewart; Anacardiaceæ; (S.-Karkata sringi, H. & B.-Kakra shingi, M.-Kakkata shingi); used in cough, asthma, antid. to snake venom and scorpion-sting; essen. oil; Ind. For. 1912, 160.*

P. lentiscus Linn. (H.-Rumi mastiki, B.-Rumi-mastungi); stim., diur., used in dentistry; resin, essen. oil; Arch. Pharm. 1904, 104, Chem. News. 1896, 120; Schim. Ber. 1915, 36.

P. terebinthus Linn. (H. & Bo.-Kabuli mustaki); astrin., restor.; resin, essen. oil; Arch. Pharm. 1881, 170 227; C. C. 1898, I, 1300; 1925, II, 926.

P. vera Linn. (H., B. & Bo.-Pista); sedative, tonic; Jr. Pharm. Chim 1903, 272; C. C. 1929, II, 897.

Pistia stratiotes Linn.; Aroideæ; (S.-Kumbhika, H.-Jalqumbhi, B.-Tákápan, Bo.-Prashni, M.-Agasatamare); demulc., refrig., emol., laxt., diur.

Pisum sativum Linn.; Leguminosæ; believed to cause dysen. when eaten raw; alk. trigonelline; Ber. 1894, 796; As, 0,026 mg. in 100 g. ash of the seeds; Compt. Rend., 1912, 893 (C. C. 1912, I. 1730).

Pithecolobium bigeminum Benth.; Leguminosæ; (H. & Bo.-Kachlora); fish poison, heart poison, remedy for leprosy; alk.; Ber. 1890, 3541; C. C. 1906, I, 1440.

P. fasciculatum Benth.

P. lobatum Benth.; alk.;

Pittosporum floribundum W. & A.; Pittosporeæ; (Bo.-Vehkali); expect., febge., narcotic, antid. to snake-poison; bitter glucd., essen. oil; J. C. S., 1906, 1083; Bull. Imp. Inst. Lond., 1927, 107; Pharm. Ind. Vol. I, 154.†

Plantago amplexicculis Cav.; Plantagineæ; (P.-Isafghol); use similar to that of P. OVATA, antid. to snake-bite.

P. brachyphylaa Edgew; (Pushtu—Parharpángi); applied to wounds.

P. ciliata Desf.

P. lanceolata Linn. (H.-Baltanga, B.-Bartung); seeds—purg., hæmostatic, leaves—applied to wounds; glucd. aucubin; Ber. 1927, 935; Compt. Rend 1902, 1441.

P. major Linn. (H.-Lahuriya, Bo.-Bártang); glucd. aucubin; Jr. Pharm. Chim. 1907, 254; Jr. Pharm. Soc. Japan. 1924., 5.†

P. ovata Forsk. (H.-Ispaghul, B.-Isabgul, Bo.-Isabghol, M.-Ishappukolvirai); used in chr. dysen. and diar., cooling, diur.; muci.*†

P. psyllium Linn.; used as P. OVATA; glucd. aucubin; Jr. Pharm. Chim. 1907, 254.

P. pumila Willd.

P. stocksii Boiss.

P. tibetica Hk. & T.

Four species of Plantago are uninvestigated.

Platanus orientalis Linn.; Platanaceæ; (Kash.-Buin); leaves—in ophthalmia, bark—in diar.; allantoin, asparagin; Ber, 1881, 1602; Z. Physiol. Chem., 1885, 420.

Pleopeltis lanceolata Linn.; tea made from this fern cures itch.

Plesmonium margaritiferum Schott.; Aroideæ; (Goa.-Aroamt); seeds—local anæsthetic.

Pluchea indica Less.; Compositæ (B.-Kukronda); astrin., febge.; essen. oil; Schim. Ber., 1912, April 103.

P. lanceolata Oliv. (P.-Marmandai, Bo.-Kura-sanna); leaves—aper., subst. for Senna.

Plumbago rosea Linn.; Plumbagineæ; (S.-Chitraka, H., B. & Bo.-Lal chitra, M.-Chittur-mol); appetiser, used in leucoderma, other skin diseases, piles and scorpion-sting; plumbagin; Jr. Pharm. Chim. 1828, 441; Jr. Ind. Chem. Soc., 1928, 419; C. C. 1929, 662.*

P. zeylanica Linn. (S.-Chitraka, H. & B.-Chita, Bo.-Chitaro, M.-Chittira); use same as P. ROSEA; Pharm. Post., 1889, 145; Jr. Ind. C. S., 1928, 419.*

Plumeria acutifolia, Poir.; Apocynaceæ; (S.-Kshira champa, H. & Bo.-Khair champa, B.-Gobar champa, M.-Vadagannern); purg., rubft., antiherpetic, used in gonor., antid. to snake poison; bitter glucd., essen. oil; plumeric acid; C C. 1899, II, 879; 1901 I, 784; C. C. 1926. I. 2111; Phil. Jr. Sci., 1909, 131.

Poa cynosuroides Retz.; Gramineæ; (S.-Kusa, H., B. & Bo.-Kusha); root—used in dysen., menor.

Podophyllum emodi Wall.; Berberideæ; (H.-Papra); purg. and cholag.; podophyllin, podophyllotoxin; Pharm. Jr., 1911, 156; 1892, 207.*†

Pogostemon parviflorus Benth., Labiatæ; (Bo-Pángala); styptic, in scorpion-sting and snake-bite; alk., essen. oil; Pharm. Ind. Vol. III, 101.

Pogostemon patchouli Pellet. (H.-Pacholi, B.-Pachápát, Bo.-Patch pan); diur., carmin., insecticide; essen. oil; Amer. Jr. Pharm., 1918, 733; Schim. Ber., 1919, 89; 1930, 61; Bull. Imp. Inst. Lond., 1924, 271; 1920, 346.†

P. plectranthoides Desf. (Dec.-Pangla); use same as P. PARVIFLORUS.

P. purpusascens Dalz. (Dec.-Pangla); use same as P. PARVIFLORUS.

Poinciana elata Linn.; Leguminosæ; (Bo.-Váyni, M.-Pade narayanam); used in rheum., flatulence.

P. pulcherrima Linn. (H. & B.-Krishna chura, M.-Maih kannai); emmen., purg; Jr. de Pharm., 1833, 625

Polianthes tuberosa Linn.; Amaryllideæ; (S. & B.-Rajanigandha, H. & Bo.-Gulcheri, M.-Nela-sampenga); flowers—diur., emetic; essen. oil; Schim. Ber., 1903, April, 74; C. C. 1926. I, 2010.

Polyalthia longifolia Benth. & Hook.; Anonaceæ; (H. & B.-Devdaru, Bo.-Asoke, M.-Assothi); febge.

Polycarpæa corymbosa Lamk.; Caryophylleæ (M.-Nilaisedachi); remedy for venomous bite.

Polygala chinensis Linn.; Polygaleæ; (H.-Meradu, Bo.-Negli); use similar to Senega.

Polygala crotalarioides Ham. (Santh.-Lil kathi); expect., purg., cure for snake-bite.

P. elongata Klein.; Polygaleæ; (M.-Periyananka); used in biliousness and constip., specific for snake poison.

P. telephioides Willd.; expect, cure for snake-bite.

P. vulgaris Thunb.; expect., tonic, purg., use like Senega.

Polygonum alatum Ham.; Polygonaceæ; (P.-Sat balon); astrin.

P. aviculare Linn. (S.-Nisomali, H.-Ban natia, B.-Machutie) astrin., antisep.; polygonic acid, essen. oil; C. C. 1917, II. 393; Arch. Pharm., 1905, 443; Year Book of Pharmacy, 1885, 160.

P. barbatum Linn.; (P.-Narri, B.-Bekh-unjubaz, M.-Atalari) use similar to P. AVICULARE.

P. bistorta Linn.; oxymethyl-anthraquinones, Ca-oxalate; Bull. Sc. Pharmac., 1925, 27; 1926, 138; Pharm. Jr., 1900, 491; Jr. Pharm. Belg., 1920, 876.

P. cymosum Roxb.; anthelm., in bites of scorpion and insects; Chinese Mat. Med.

P. flaccidum Roxb.; used in insect and snake-bite; Chinese Mat. Med.

P. glabra Willd. (B.-Bihagni, Bo.-Raktarohida, M.-Atlaria); used in colic, febge.

P. hydropiper Linn. (B.-Packur-mul); diur., carmin., anthelm.; essen. oil, oxymethyl-anthraquinones; Bull. Sc. Pharmac., 1925, 27; 1926, 138; Pharm. Weekbl., 1919, 1084.

P. molle Don. (Nep.-Patu-swa).

P. persicaria Linn.; use same as other species.

P. plebejum Br. (Santhal.-Raniphul); root—given in bowel complaints.

P. viviparum Linn. (P.-Maslun); root—astrin., used in diar., dysen., fever, sore throat and hæmoptysis.

Polypodium quercifolium Linn.; (Bo.-Kadikapana); used in phthisis, fever, dyspep.

P. vulgare Linn. (Ind. Baz.-Basfaij); aper., alter.

Polyporus officinalis Fries.; (Ind. Baz.-Gharikum); used in phthisis, diar.; bitter substance; Jr. Pharm. Chim., XXI, 279.

Pongamia glabra Vent.; Leguminosæ; (S., H. & Bo.-Karanja, B.-Dahar karanja, M.-Pungammaram); in scorpion-sting, oil—used in skin diseases, leaves—in diar., remedy for cough, as cholag; bitter substance; Jr. Amer. Pharm. Assoc., 1926, 1086; Jr. Ind. Inst. Sci., 1923, 93.*

Populus ciliata Wall.; Salicineæ; (Nep.-Bangikat Kash.-Falsh); tonic, stim.

P. euphratica Oliv. (P. & Bo.-Safeda); vermifuge.

P. nigra Linn. (Kash.-Frast); depurative, buds—used for hæmorrhoids, decoct of bark—for colds; glucd., salicin, populin, chrysin, essen. oil; Ann. Chem., 1857, 372; Jr. Prakt. Chem., 1911, 483; Schim. Ber., 1912, Oct. 81.†

Porphyra vulgaris Linn.; Florideæ; (Bo.-Las); demulc., alter., in scrofula; iodine.

Portulaca meridiana Linn.; Portulaceæ; (B.-Nooni shak, Bo.-Kurfa); use similar to P. QUADRIFIDA.

P. oleracea Linn. (S.-Lonika, H.-Khursa, B.-Baraloniya, Bo.-Kurfáh, M.-Parukire); use similar to P. QUADRIFIDA

P. quadrifida Linn. (S.-Upadyki, H. & B.-Lonia, Bo.-Kota, M.-Passrai keeray); used in skin diseases, in diseases of the kidney, bladder, lungs.

P. sativa Linn.; cooling, astrin., dumulc.; Stewart, Punj. Plants.

P. tuberosa Roxb. (Bo.-Lunuk, M.-Boddakura); applied to erysipelas and internally in dysuria.

Potentilla fruticosa Linn.; Rosaceæ; (P.-Spang-jhá); subst. for tea; Stewart, Punj. Plants.

P. nepalensis Hook. (P.-Rattonjot); root—depurative.

P. reptans Linn.; use same as P. NEPALENSIS.

P. supina Linn.; root—febge., astrin., tonic.

Pothos scandens Linn.; Aroideæ; used in snake-bite.

Pouzolzia indica Gaud.; Urticaceæ; (M.-Kalluruki); used in syphilis, gonor. and snake poison.

Prangos pabularia Lindl.; Umbelliferæ; (S.-Avipriya, H.-Komal); carmin., diur., emmen.; essen. oil, alk., valeric acid; Pharm. Ind. Vol. II, 140.

Premna esculenta Roxb.; Verbenaceæ; leaves used medicinally.

P. herbacea Roxb. (S.-Bhargi, H.-Bharangi, B.-Bamanpati, M.-Shiruket); bitter, stomch., used in scorpion-sting, asthma, rheum., and in dropsy; alk.

P. integrifolia Linn. (S.-Ganikáriká, H. & Bo.-Arni, B.-Ganiari, M.-Munni-vayz); cordial, stomch., used in rheum., neuralgia; alk.†

P. latifolia Roxb. (H.-Bakar); leaves—diur., externally applied in dropsy

P. mucronata Roxb. (H.-Baker); useful in boils and colic.

P. tomentosa Willd. (M.-Kollay-cottaynellay); used in dropsy.

Primula reticulata Wall.; Primulaceæ; (Kumaon.-Bisheopra); anodyne, poisonous to cattle.

P. verticillata *Forsk.;* P. capitata *Hook.*, P. mollis *Hook.* and P. japonica *Grav.;* contain glucd.; Compt. Rend., 1924, 780 & 991; (C. C., 1925, I., 41, 833); 1925, 1421 (C. C., 1925, II. 408).

Prinsepia utilis Royle.; Rosaceæ; (H.-Vhekal); oil—rubft., applied externally in rheum.

Prosopis spicigera Linn.; Leguminosæ; (B. & Bo.-Shami, H.-Jhand, M.-Perumbe); pod—astrin., bark—in rheum. and scorpion-sting.

Prunella vulgaris Linn; Labiatæ; expect., antisp.; Stewart, Punj Plants.

Prunus amygdalus Baill.; Rosaceæ; (H., B. & Bo.-Badam, M.-Vádam-Kottai); demulc., stim., nervine tonic; HCN-glucd. As—0,025 mg. in 100 g. fruit; Compt. Rend. 1912, 893 (C. C. 1912. I. 1730); J. C. S., 1909, 927; Arch. Pharm., 1908, 206 & 509; 1909, 226 & 542; 1910, 101; 1925, 563; Ber. 1923, 857.†

P. armeniaca Linn. (H.-Khubani, P.-Gurdlu); laxt., refrig., in fever; C. C. 1927, I, 532; Chem. News, 1921, 162; Ber. Pharm. Ges., 1922, 240; Jr. Amer. C. S., 1924, 2506.†

Prunus avium Linn.; leaves contain Ba; Chem. News. 1916, 62.

P. cerasus Linn. (H.-Alu-bálu, P.-Gilas); bark—bitter, astrin., febge., kernel—nerve tonic; HCN; Schim. Ber., 1913, April, 109.

P. communis Huds. (H. & B.-Alu-bokhárá, M.-Alpogádá-pazham); fruit —laxt., root—astrin.

P. insititia Linn. (Ind. Baz.-Alu-bokhárá, acid, astrin., aper., digestive.

P. mahaleb Linn. (S.-Priyangu); tonic, stomch., diur., in scropion-sting; coumarin, salicylic acid, amygdalin; C. C. 1905, II, 1503; Ann. Chem., 1851, 83; 1852, 243; C. C. 1905, II, 1503.

P. padus Linn. (H.-Jamana P.-Jamma); HCN-glucd.; Z. Oesterr. Apoth.-Ver.; 1892, 330; Arch. Pharm., 1905, 421; 1913, 56; Jr. Pharm. Chim., 1907, 194.

P. persica Benth & Hook. (H.-Aru); flowers—purg., fruit—stomch., demulc., antiscor.; prussic acid; Analyst, 1904, 105; Jr. Amer. C. S., 1896, 609; 1921 1725.

P. puddum Roxb. (S.-Padmaka, H.-Paddam, Bo.-Padma-kasta); branches —subst. for HCN, in scorpion-sting, kernel used in gravel; amygdalin; Arch. Pharm., 1906, 398.

P. undulata Ham.; fruits and leaves—HCN; Arch. Pharm., 1906, 398 and 670.

Psammogeton biternatum Edgw.; Umbelliferæ; (Pushtu.-Gargira); stomch.

Pseudarthria viscida W. & A.; Leguminosæ (S.-Sanaparni, M.-Neermali); used in biliousness, rheum., excessive heat, intestinal poison, fever, diar., asthma, heart disease, worm and piles.

Psidium guyava Linn.; Myrtaceæ; (S.-Amrutafalam, H.-Amrut, B.-Peara, Bo.-Perala, M.-Goyyá-pazham); bark—astrin., febge., antisp., fruit—laxt., leaves—astrin.; essen. oil, eugenol; Chem. Drug., 1905, 14.

Psoralea corylifolia Linn.; Leguminosæ; (S.-Vakuchi, H. & B.-Babachi, Bo.-Bobawachi, M.-Karpo-Karishi); seeds—given in scorpion-sting, snake-bite, leucoderma and other skin diseases; Jr. Soc. Chem. Ind., 1910, 1428; I. J. M. R. 1927, 49.*

Psychotria curviflora Thw.; Rubiaceæ; (M.-Vellakurinji); decoct. of the root—used in rheum., pneumonia, head-disorders, ear and eye diseases and sore-throat.

P. ipecacuanha Linn.; Rubiaceæ; emetic, used in dysen.*

The following species of Psychotria are uninvestigated:—
Psychotria adenophylla *Wall.*, P. anamallayana *Bedd.*, P. andamanica *Kurz.*, P. calocarpa *Kurz.*, P. congesta *W. & A.*, P. Connata *Wall.*, P. dalzellii *Hook.*, P. denticulata *Wall.*, P. divergens *Kurz.*, P. elongata *Hook.*, P. erratica *Hook.*, P. fulva *Ham.*, P. gardneri *Hook.*, P. helferiana *Kurz.*, P. Johnsoni *Hook.*, P. longipetiolata *Thw.*, P. macrocarpa *Hook.*, P. madraspatana *Hook.*, P. montana *Blume.*, P. moonii *Hook.*, P. nudiflora *W. & A.*, P. ovoidea *Wall.*, P. pendula *Hook.*, P. platyneura *Kurz.*, P. sarmentosa *Blume.*, P. silhetensis *Hook.*, P. sordida *Thw.*, P. subintegra *Hook.*, P. sulcata *Wall.*, P. symplocifolia *Kurz.*, P. thomsoni *Hook.*, P. thwaitesii *Hook.*, P. truncata *Wall.*

Pteris aquilina Linn. (P.-Kakhash); rhizome—astrin., anthelm.

Pterocarpus indicus Willd.; Leguminosæ; (M.-Erravegisa, B.-Padauk); gum—subst. for gum kino; Ber. Pharm. Ges., 1913, 88.

P. marsupium Roxb. (H.-Bijasár, B.-Pitsal, Bo.-Bibla, M.-Vengai-maram); astrin.; J. C. S., 1911, 1530; Pharm. Jr., 1900, 226; 1903, 840.

P. santalinus Linn. (S., H., B. & Bo.-Raktachandana, M.-Shen chandanam); astrin., cooling, in inflam., headache, scorpion-sting, tonic; glucd coloring matter; J. C. S., 1912, 1061; Arch Pharm., 1929, 81.

Pterospermum acerifolium Willd.; Sterculiaceæ; (S.-Karnikara, H.-Kaniar, B. & Bo.-Kanak champá, M.-Matsakanda); flowers & bark—applied to suppurating small pox, leaves—hæmostatic.
P. heyneanum Wall.; used in leucor., smoked like tobacco.
P. suberifolium Lam. (S.-Muchukunda, H. & B.-Much kund, Bo.-Muchu kunda, M.-Taddo); remedy for hemicrania.
Ptychotis ajowan DC.; Umbelliferæ; antisep., stomch., carmin., stim.; essen. oil, thymol; Schim. Ber., 1903, Oct. 82; 1920, 3; Perf. Rec., 1923, 399; Bull. Imp. Inst. Lond. 1918, 30; Jr. Soc. Chem. Ind., 1918, 604.
Pueraria tuberosa DC.; Leguminosæ; (H.-Siali, Bo.-Dári, M.-Dari-gummadi); used as a cataplasm to reduce swellings.
Pulicaria crispa Benth.; Compositæ; (H.-Burhna, P.-Bui); antisep.
Puneeria coagulans Stocks.; Solanaceæ; emetic, anodyne, sedative, in colic, dyspep.; Murray, Drugs of Sind.
Punica granatum Linn.; Lythraceæ; (S.-Darimba, H.-Anar-ke-per, B.-Dalim, Bo.-Dalimba, M.-Madalai); astrin., anthelm., in scorpion-sting; alk. pelletierine, etc.; Arch. Pharm. 1899, 49; Ber., 1917, 368; 1919, 1005.†
Putranjiva roxburghii Wall.; Euphorbiaceæ; (S. & B.-Putranjiva, H.-Jiaputa, Bo.-Puta-jan, M.-Karupale); used in colds and fevers.
Pyrethrum indicum DC.; Compositæ; see CHRYSANTHEMUM INDICA.†
P. umbelliferum Boiss. (H.-Mitha-akarkara); aphrodis., tonic, abortif., anthelm.; pyrethrine; Pharm. Ind. Vol. II, 282.
Pyrus aucuparia Gærtn.; Rosaceæ; (P.-Battal); bark—HCN-glucd.; Ann. Chem., 1851, 79; 1852, 242.
P. chinensis Roxb.; used medicinally; Chinese Mat. Med.
P. communis Linn.; (S.-Amritaphala, H.-Náshpáti); astrin., sedative, febge.; Chinese Mat. Med.
P. cydonia Linn. (H. & B.-Bihidana, M.-Shimai madalaivirai); mucil., demulc., astrin.; see CYDONIA VULGARIS.
P. malus Willd.; root—anthelm., refrig., hypnotic; Chinese Mat. Med.
P. tomentosa Roxb.; fruit—tonic, febge.; Chinese Mat. Med.

Quercus incana Roxb.; Cupuliferæ; (Kash.-Sila, P.-Bán); diur., astrin., used in asthma.
Q. infectoria Oliv. (S., H. & B.-Majuphal, Bo.-Maiphal, M.-Mashikkay); astrin., used in intertrigo, impetigo, eczema; J. C. S., 1897, 1131; Chem. Ztg., 1908, 918; Ber., 1914, 2485.†
Q. lamellosa Smith. (Nep.-Shalshi); bark and acorns—used in medicine.
Q. pachyphylla Kurz. (Nep.-Barakatus); bark and acorns—astrin.
Quisqualis indica Linn.; Combretaceæ; (H.-Rangan-ki-bel, Bo.-Vilayeti-chambeli, M.-Irangul-malli); anthelm.; gum; Phil. Jr. Sci., 1917, 157.†

Randia dumetorum Lam.; Rubiaceæ; (S.-Madan, H.-Mainphal, B.-Menphal, Bo.-Gelaphal, M.-Maruk-kallan-kai); emetic., used in dysen., scorpion-sting and as fish poison; saponin, essen. oil; Pb. in seeds; Arch. Pharm., 1894, 489; Chem. & Drug., 1891, 460.†
R. tetrasperma Benth & Hook. (Kumaon.-Bara garri).
R. uliginosa DC. (S.-Pindaluka, H.-Pindalu, B.-Piralu, Bo.-Pendari, M.-Wagata); remedy for dysen., diar.
Ranunculus arvensis Linn.; Ranunculaceæ; (P.-Chambul); used as fodder but frequently produces symptoms of irrit. poisoning, leaves—HCN; Jr. Pharm. Chim., 1906, (6), 355.

Ranunculus sceleratus Linn.; (Pers.-Kabiraj); emmen., galact., used in skin diseases, anemonin; Arch. Pharm., 1892, 182.
About twenty specis of Ranunculus are uninvestigated.
Raphanus sativus Linn.; Cruciferæ; (S.-Mulaka, H. & B.-Mula, Bo.-Muro, M.-Mullangi); diur., laxt., essen. oil; As, 0,01 mg. in 100g. root; Compt. Rend. 1912, 893 (C. C. 1912. I. 1730); Pharm. Ind., Vol. I, p. 129.†
Rauwolfia serpentina Benth.; Apocynaceæ; (S.-Sarpagandha, H.-Chota chand, B. & Bo.-Chandra, M.-Covannamilpori); hypnotic, sedative, in hyperpiesis, in scorpion-sting, specific for insanity; Jr. Ind. C. S. 1931, 667.*
About seven species of Rauwolfia are uninvestigated.
Reaumuria hypericoides Willd.; Tamariscineæ (Bo.-Lanisah); used in prurigo and itch.
Reinwardtia trigyna Planch.; Lineæ; (P.-Karkun); cattle medicine.
Remusatia vivipara Schott.; Aroideæ; (Bo.-Rukh-alu); root—remedy for itch.
Rhabdia lycioides Mart.; Hydrophyllaceæ; (S.-Pashanabheda, M.-Cheppunerinjal); root—used in piles, stone in bladder, syphilis, venereal diseases.
Rhamnus dahuricus Lawson.; Rhamneæ; (H.-Chandua, P.-Chetain); emetic, purg., used in affections of spleen; oxymethyl-anthraquinones, rhamnose; Bull. Sc. Pharm., 1924, 135; Compt. Rend., 1924, 1312; 1925, 925; Arch. Pharm., 1914, 165.†
R. purpurens Edgew. (P.-Bat-sinjal); purg.
R. triqueter Lawson. (P.-Gardhan, H.-Ghant); use similar to R. WIGHTII.
R. wightii W. & A. (Bo.-Raktarohida); tonic, astrin., cryst. bitter substance, cath. acid; Pharm. Jr., Feb. 1888.
About four species of Rhamnus are uninvestigated.
Rhaphidophora pertusa Schott.; Aroideæ; (Bo.-Ganesh kanda); used in snake-bite and scorpion-sting.
Rhazya stricta Dcne.; Apocynaceæ; (H.-Sunwar, Bo.-Sewar); bitter tonic.
Rheum acuminatum Hk. f.& T.; Polygonaceæ; use same as R. EMODI.
R. emodi Wall. (H. & B.-Revandchini, Bo.-Ladaki-revanda chini, M.-Nattu-ireval-chinni); purg.; glucd. rhaponticin, chrysophanic acid; leaves—oxalic acid; Apoth. Ztg., 1921, 169; J. C. S., 1915, 946; Pharm. Weekbl., 1917, 1234.* †
R. moorcroftianum Royle.; vern. and use same as R. EMODI.
R. nobile Hk. f. & T.; vern. and use same as R. EMODI.
R. officinale Baillon.; chrysophanic acid, rhein., emodin, etc.; Pharm. Weekbl., 1904, 177; Arch. Pharm., 1907, 141.
R. palmatum Linn. (Ind. Baz.-Rewand chini); chrysophanic acid, emodin, etc.; Ber., 1882, 902; Arch. Pharm., 1918, 91.
R. webbianum Royle.; vern. and use same as R. EMODI.
Rhinacanthus communis Nees.; Acanthaceæ; (S.Juthika purni, H.-Palak juhi, B.-Juipana, Bo.-Gach karan, M.-Nagamalli); used in skin diseases and snake-bite; rhinacanthin; S.-Ber. Dorpat. Naturf. Ges., 1883, 277; Year Book of Pharm., 1881, 197.
Rhizophora mangle Linn.; Rhizophoreæ; astrin.; Chinese Mat. Med.
R. mucronata Lamk. (B.-Bhora, Bo.-Kamo, M.-Upupoma); astrin. cure for diabetes; tannin; Jr. Soc. Chem. Ind., 1917, 188.
Rhododendron anthopogon D. Don.; Ericaceæ; (Kash.-Tazak-tsun); arom., stim.
R. arboreum Sm. (P.-Ardawal); poisonous; ericolin.
R. barbatum Wall. (Nep.-Gurás); fish poison; tox. bitter substance andromedo toxin; Arch. Pharm., 1885, 1905.

Rhododendron campanulatum Don. (H.-Cherailu, Kash.-Gaggar); useful in colds, hemicrania, rheum., sciatica.
R. cinnabarinum Hook. (Nep.-Bulu); leaves—poisonous to cattle; tox. bitter principle; Arch. Pharm., 1885, 1905.†
R. falconeri Hook. (Nep.-Kurlinga); fish poison; tox. bitter substance, glucd. ericolin; Arch. Pharm., 1885, 905; 1889, 277; 1891, 552.
R. lepidotum Wall. (Bhutia.-Tsalsuma); use similar to R. ANTHOPOGON.
R. setosum Don. (Bhutia.-Tsallu); use similar to R. ANTHOPOGON.
About forty species of Rhododendron are uninvestigated.
Rhus coriaria Linn.; Anacardiaceæ; (H.-Tatrak, B.-Sumok, Bo.-Sumák); astrin., styptic, tonic, diur., used in dysen., hæmoptysis, conjunctivites; Jr. Soc. Chem. Ind., 1904, 1137; Proc. Chem. Soc., 1897-98, Nos. 193, 104.
R. insignis Hook. (Nep.-Khagphulai); vesicant, given in colic.
R. parviflora Roxb. (H.-Raitung).
R. semi-alata Murr. (H.-Tatri); fruit—in colic.
R. succedanea Linn. (S.-Karkata sringi, H. & B.-Kakrasingi, Bo.-Takadasingi); use similar to P. INTEGERRIMA; Ber. 1907, 4784; Arch. Pharm., 1909, 650.
R. wallichii Hook. (Nep.-Chosi, H.-Akoria); juice of leaves—corrosive.
Rhynchocarpa fœtida Schrad.; Cucurbitaceæ; (M.-Appakovay); demulc., in piles and asthma.
Rhynchospermum verticillatum Rein.; Compositæ; (P.-Hukmandáz).
Ribes grossularia Linn.; Saxifragaceæ; (P.-Amlanch, Kumaon.-Baikunti); fresh leaves—HCN; Arch. Pharm., 1906, 671.
R. nigrum Linn.; (P.-Nábar); laxt., cooling; essen. oil; Schim. Ber., 1907, April, 114; Jr. Soc. Chem. Ind., 1926, 301.
R. orientale Poir. (P.-Nyai phulánch, H.-Gwáldakh); purg.
R. rubrum Linn.; (P.-Dak); fresh leaves—HCN; Compt. Rend., 1905, 448.
Ricinus communis Linn.; Euphorbiaceæ; (S.-Eranda, H.-Arand, B.-Verenda, Bo.-Erendi, M.-Amanakham chedi); seeds—counter-irrit., in scorpion-sting, purg.* †
Rivea ornata Chois.; Convolvulaceæ; (Bo.-Phand); in pityriasis and in piles.
Rosa alba Linn.; Rosaceæ; (H.-Swet gulab); flowers—in fever and palpitation of heart, petals—laxt.†
R. centifolia Linn. (H. & B.-Gulab, M.-Troja); astrin., laxt., carmin., officinal in Pharmacopœia of India.
R. damascena Mill. (S.-Satapatri, H.-Gulap-ke-phul, B.-Golapphul, Bo.-Gul, M.-Golappu); astrin., aper., cardiac tonic; essen. oil; Schim. Ber., 1920, 50; Jr. Soc. Chem. Ind., 1922, 192.
R. gallica Linn. (H. & B.-Gulap); tonic, astrin.; officinal in Pharmacopœias of Europe and India.
R. moschata Mill. (S.-Kubjaka, H.-Kujai, B.-Kuja); beneficial in bilious affections and burning of skin, eye diseases.
Roscoea purpurea Royle.; Scitamineæ; used in vet. medicine; Stewart, Punj. Plants.
Rosmarinus officinalis Linn.; Labiatæ; (H.-Rusmari); oil—carmin., stim., Schim. Ber., 1904, Oct. '82· Parf. Moderne, 1924, 232; Bull. Imp. Inst. Lond., 1927, 107.
Rourea santaloides W. & A.; *Connoraceæ*; (Bo.-Vardara); bitter tonic, promotes growth of fœtus, used in rheum., diabetes and pulmonary complaints.
Roylea elegans Wall.; Labiatæ; (H.-Patkarru, P.-Kauri); bitter, febge.
Rubia cordifolia Linn.; Rubiaceæ· (S. & B.-Manjistha, H.-Manjith, Bo.-Manjit, M.-Manjitti); astrin., used in cobra-bite and scorpion-sting; glucd. munjistin; J. C. S., 1893, 1157.

Rubia tinctorum Linn. (P.-Bacho, Bo.-Manyunth); acts on the nervous and uterine systems; glucd. munjisti.
Rubus fruticosus Linn.; Rosaceæ; (P.-Alish, Akhi); Z. Physiol. Chem., 1923, 309.
R. moluccanus Linn.; (Kumaon.-Katson); astrin., emmen., abortif.
Ruellia prostrata Lamk.; Acanthaceæ; used in gonor.
R. suffruticosa Roxb. (Santh.-Chaulia); used in gonor., syphilis and renal affections.
Rumex acetosella Linn.; Polygonaceæ; (S.-Chutrika, B.-Chukapalam); antiscor.; K-oxalate; Weinhold, Landw. Versucht, 4, 188.
R. crispus. (S.-Amla-betasa); see R. VESICARIUS; emodin, chrysophanic acid, essen. oil.; Compt. Rend., 1886, 1043; Pharm. Jr. 1927, 105; C. C. 1920, III, 353.
R. dentatus Linn. (S.-Changeri, H.-Ambavati, H.-Amrule); antiscor.
R. maritimus Linn. (H.-Jungli palak, B.-Banpalang); cooling, applied to burns; Pharm. Jr., 1911, 350.
R. nepalensis Spreng.; roots—purg., subst. for rhubarb.
R. vesicarius Linn. (S.-Chukra, H., B. & Bo.-Chuka, M.-Shakkan kirai); stomch., diur., astrin.; used in snake-bite and scorpion-sting.
Rungia parviflora Nees.; Acanthaceæ; (S.-Pindi, M.-Punaka-pundu); leaves—cooling, aper., febge.
R. repens Nees. (M.-Kodagasaleh); diur., given in snake-bite, vermifuge.
Ruta graveolens Linn.; Rutaceæ; (S.-Somalata, H.-Sadáb, B.-Ermul, Bo.-Satap, M.-Arvada); antisp., stim., emen., irrit., abortif., in scorpion-sting; glucd. rutin; Arch. Pharm., 1904, 255; essen. oil; Proc. Chem. Soc., 1902, 192; Schim. Ber., 1920, 49.†

Saccharum arundinaceum Retz; Gramineæ; (P.-Sarkandá, B.-Teng, M.-Adava).
S. ciliare Anders. (S. & M.-Gundra, H.-Rámsar, B. & Bo.-Sar); refrig., aphrodis., useful in dysen., dysuria and boils, officinal in the Punjab.
S. officinarum Linn. (S.-Ikshu, H.-Ukh, B.-Ak, Bo.-Serdi, M.-Karumba); root—demulc., diur., stim.; Ca-oxalate; Compt. Rend. 1849, 613.†
Saccolabium papillosum Lindl.; Orchideæ; (Bo.-Nakuli, M.-Rasna); bitter tonic, used in rheum.; alk., bitter resin; Pharm. Ind., Vol. III, 394.
S. præmorsum Hook.; use similar to S. PAPILLOSUM.
S. wightianum Hook; use similar to S. PAPILLOSUM.
Sagittaria sagittifolia Willd.; Alismaceæ; used to induce flow of lochia, in retention of placenta and in skin diseases, Chinese Mat. Med.
Saguerus rumphii Roxb.; Palmeæ; fruits—anticoagulant; Chinese Mat. Med.
Salacia oblonga Wall.; Celastrineæ; (M.-Ponkoranti); root bark—used in gonor., rheum. and skin diseases.
S. reticulata Wight. (S.-Ekanayakam, M.-Koranti); root bark—used in gonor., rheum., and skin diseases.
Salicornia arabica W.; Chenopodiaceæ; used in medicine; Birdwood, Veg. Prod. Bombay.
S. brachiata, Roxb.; (M.-Oomarie keeray).
Salix acmophylla Boiss.; Salicineæ; (Bo.-Budha, P.-Bada); bark—febge.
S. alba Linn. (P.-Bis, Kash.-Vuir); antisep., antipyr., antiper; glucd.
S. babylonica Linn. (Nep.-Tissi, Kash.-Guir); anthelm., antisep., tonic; salicine.
S. caprea Linn. (Ind. Baz.-Bedmishee); cardiac tonic, subst. for Cinchona bark; glucd. salicine; Pharm. Ind., Vol. III, 367.
S. daphnoides Vill.; (Kash.-Yur, P.-Bedi); glucd. salicin; Pharm. Ztg., 1831, 305.

Salix tetrasperma Roxb. (H.-Baishi, B.-Pánijamá, Bo.-Bitsa, M.-Atru pâlai); bark—febge.

Salsola fœtida Delz.; Chenopodiaceæ; (P.-Motiláne, Bo.-Lánau, M.-Ellakura).

S. kali Linn.; used in the manufacture of 'sajikshar'; oxalic acid; Monatsh. Chem. 1926, 611; Ann. Pharm. 1835, 86; Monatsh. Chem. 1926, 611.

Salvadora indica Royle.; Salvadoraceæ; (H.-Jan); leaves—purg.

S. oleoides Dcne. (S., H. & B.-Pilu, Bo.-Kaukhina, M.-Ughaiputtai); stomch., used in enlarged spleen, rheum., low fevers, snake-bite, bark—vesicant; alk., trimethylamine; Pharm. Ind., II, 383.

S. persica Linn. (S.-Pilu, H. & B.-Chotapilu, Bo.-Pilvu, M.-Ughaiputtai); carmin., diur., purg., antid. to poisons; alk. trimethylamine, Jr. Ind. Inst. Sci., 1926, 117.

Salvia ægyptiaca Linn.; Labiatæ; (P.-Tukhm-malanga); demulc.

S. hæmatodes W.; (H., B. & Bo.-Lal Bahamana); used medicinally; Birdwood, Veg. Prod. Bombay.

S. lanata Roxb.

S. moorcroftiana Wall. (P.-Kallijarri); roots—in cough, seeds—emetic, in hæmorrhoides.

S. officinalis Linn. (H.-Salbia sefakuss); tonic, astrin., aroamtic; essen. oil; Schim. Ber. 1920, 142; Parf. Moderne 1923, 244; J. C S., 1877, 548; 1880, 678.

S. plebeia R. Br. (P.-Sathi, B.-Kokaburadi, Bo.-Kammar-kas); seeds—in diar., gonor. and hæmorrhoids; Ind. For. Rec., 1923, 10, 11 & 13.

S. pumila Benth.; use same as S. PLEBEIA.

Samadera indica Gærtn.; Simarubeæ; (M.-Niepa, Burm.-Kathai); bark——in fever, bitter, oil—in rheum.; glucd. samaderin, bitter substance; Arch Pharm., 1901, 96; C. C., 1900, II, 1124; Jr. Pract. Chem., 1867, 413.

S. lucida Wall. (Burm.-Kathay); use same as S. INDICA.

Sambucus ebulus Linn.; Caprifoliaceæ; (P.-Mushkiára); roots—purg., used in dropsy; cyanogenetic glucd., essen. oil; Compt. Rend. 1905, 16 and 236; Arch. Pharm., 1913, 56.†

S. nigra Linn.; flowers—stim., sudorific, laxt; cyanogenetic glucd. sambunigrin; Compt. Rend., 1905, 16; Jr. Pharm. Chim., 1905, 154, 210, 219, 385; benzaldehyde; oxalic acid in young leaves; Abderhalden's Handb. Biolog. Arbeitsmethoden, 1924 Abt. I. T. 11, 15; Compt. Rend., 1905, 59; essen. oil, alk. sambucin; Jr. Pharm. Chim., 1901, 17.†

Sandoricum indicum Cav.; Meliaceæ; (Burm.-Thitto); carmin., used in diar. and dysen.; toxic bitter substance, alk.; Meded Lands Plantent, 1899, 80 and 121.†

Sansevieria zeylanica Willd.; Hæmodoraceæ; (S.-Muruvá, H.-Murvá, B.-Murba, Bo.-Morwa M.-Marul-kalung); purg., tonic, expect., febge.; alk. sanservierine; Pharm. Ind., Vol. III, 495.

Santalum album Linn.; Santalaceæ; (S.-Swet-chandan, H.-Safedchandan, B.-Sadachandan M.-Shandanak-kattai); wood—in scorpion-sting, bark—applied in erysipelas, prurigo, paste—applied to the temple in headache, oil—expect., in gonor.; Jr. Ind. Inst. Sci., 1928, A. 11, 97; For. Bull. No. 6, 1911; J. C. S., 1918, 125; Schim. Ber., 1915, April, 42.*

Sapindus mukorossi Gærtn.; Sapindaceæ; (S.-Phenila, H., B. & Bo.-Ritha); fruits—in epilepsy; saponin; Arch. Pharm. 1901, 363.

S. trifoliatus Linn. (S.-Phenila, H., B. & Bo.-Ritha, M.-Ponnán-kottai); tonic, expect., emetic, purg., in scorpion-sting; saponin; Jr. Soc. Chem., Ind., 1910, 1431.

Sapium indicum Willd.; Euphorbiaceæ; (B.-Huruá, Bo.-Hurna); seeds—fish poison.
S. insigne Benth. (H.-Khinna, Bo.-Dudla); acrid, vesicant.
S. sebiferum Roxb.; (S.-Toyapippali, H.-Pippal-Yang, B.-Momchina); diur., in snake-bite and boils; Arch. Pharm., 1925, 186.
Saponaria vaccaria Linn; Caryophylleæ; (H.-Musna, B.-Sabuni) febge., sap—in itch.; saponin; Pharm. Ind., Vol. I, 157; Arch. de Pharm., 432, 481.
Saraca indica Linn.; Leguminosæ; (S.-Asoka, H., B. & Bo.-Asok, M.-Asek); used in uterine affetcions, in menor., scorpion-sting; Pharm. Post. 1887, 778.
Sarcocephalus horsfeldii Miq.; Rubiaceæ; alk.; Meded. Lands Plantent, 1898, 92.
S. missionis Wall.; (S.-Jalamdasa, M.-Nirvanji); powdered bark or decoct. used in leprosy, ulcers, rheum., constip.
Sarcostemma brevistigma W. & A.; Asclepiadeæ; (S. & Bo.-Soma, H. & B.-Somlatá, M.-Kondapála); used to prepare intoxicating liquor.
S. brunonianum W. & A.; vern. and use same as S. BREVISTIGMA.
S. intermedium Dcne.; vern. and use same as S. BREVISTIGMA.
S. stocksii Hook.; vern. and use same as S. BREVISTIGMA.
Sarcostigma kleinii W. & A.; Olacineæ; (Puvenagah); used in rheum.
Sassafras officinale Nees.; Laurineæ; root—in rheum. and skin disease; essen. oil; Schim. Ber. 1925, 72; 1923, 71.
Sauromatum guttatum Schot.; Araceæ; tubers—stimulating poultice.
S. pedatum Schot. (Bo.-Lot); tubers—acrid, poisonous and externally as stimulating poultice.
Saussurea candicans Clarke; Compositæ; (P.-Batula); carmin.
S. hypoleuca Spreng.; subst. for S. LAPPA.
S. lappa. Clarke; (S.-Kushtha, H.-Kut, B.-Pachak, Bo.-Ouplate, M.-Goshtam); carmin., stim., in scorpion-sting, root—used in asthma; essen. oil, alk. saussurine; Chem. & Drug. 1924, 413; Schim. Ber. 1892, 41; 1896, April, 42; Board Sc. Adv. India, 1911-12, 31; Ber. 1914, 2433 and 2687; Jr. Ind. C. S. 1929, 519.*†
S. obvallata Wall. (P.-Kanwal); root—applied to bruises and cuts.

The following species of Saussurea are uninvestigated:—
S. affinis *Spreng.*, S. albescens *Hook.*, S. bracteata *Dcne.*, S. candolleana *Wall.*, S. deltoidea *Clarke.*, S. denticulata *Wall.*, S. graminifolia *Wall.*, S. jacea *Clarke.*, S. kunthiana *Clarke.*, S. subulata *Clarke.*, S. uniflora *Wall.*, S. wernerioides *Schultz.*
Saxifraga ligulata Wall.; Saxifragaceæ; (S.-Pashanveda, H.-Pakhanbed); root—used in diar. and pulmonary affections; Pharm. Jr., 1888, 123.
Scævola kœnigii Vahl.; Goodenovieæ; (Bo.-Bhadrak); prophylactic against beri-beri, juice of berries—clears opacity of eye; bitter substance and glucd.; Meded. Lands Plantent 1894, 33, 1899, 133; Pharm. Weekbl. 1896. Nr. 48.
Schima wallichii Chois.; Ternstrœmiaceæ; (H.-Chilauni); irritates skin; saponin; Meded. Lands. Plantent. 10, 23; Bull. Inst. Bot. Buitenzorg, 1904, 3.
Schleichera trijuga Willd.; Sapindaceæ; (H.-Kosum, Bo.-Kosam, M.-Pu-maram); bark—astrin., oil—promotes hair growth; syanogenetic glucd.; Jr. Soc. Chem. Ind., 1920, 88; Analyst 1915, 3; Apoth. Ztg. 1920, 17; Pharm. Centralh. 1891, 396; Amer. Chem. Jr. 1894, 467.†
Schrebera swietenioides Roxb.; Oleaceæ; (M.-Mogalinga-maram); used in the preparation of an oil for burns and boils.
Schweinfurthia sphærocarpa Braun.; Scrophularineæ; (S., H. & Bo.-Sanipát); diur., used in fever; alk.; Pharm. Ind., Vol. III, 6.
Scilla coromandeliana Roxb.; Liliaceæ; used as a subst. for Squill.

Scilla hyacinthina.; Liliaceæ; remedy for stangury and fever in horses.
S. indica Baker.; (H. & B.-Suphadie-khus, Bo.-Bhui-kanda, M.-Shiru-nari-vengayam); expect., cardiac tonic, diur.
Scindapsus officinalis Schot.; Aroideæ; (H. & B.-Gajapipal, Bo.-Thora-pimpli, M.-Atti-tippili); arom., carmin., stim.; alk.; Pharm. Ind., III, 544.†
Scirpus articulatus Linn.; Cyperaceæ; (S. & H.-Chichora); purg.
S. grossus Linn.; vern. and use same as S. KYSOOR.
S. kysoor Roxb. (S.-Kesharuka, H. & B.-Keshur, Bo.-Kachera, M.-Gunda-tunga-gaddi); tubers—used in diar. and vomiting.
Scoparia dulcis Linn.; Scrophularineæ; alk; Meded. Lands Plantent, 1897, 83; 1899, 135.
Scopolia lurida Dunal.; Solanaceæ; subst. for belladonna; hyoscyamine, hyoscine; Arch. Pharm., 1890, 145; 1891, 492.†
S. prœalta Dunal.; poisonous and narcotic, used like belladonna, leaves—said to dilate the pupils.
Scutellaria galericulata Linn.; Labiatæ; glucd. scutellarin; C. C., 1923. III. 244.
S. indica Linn.; glucd. scutellarin; C. C., 1923, III. 244.
Sebastiana chamælea Muell.; Euphorbiaceæ; juice—astrin.
Secamone emetica Br.; Asclepiadeæ; (B.-Shada-buri); root—emetic.
Securinega leucopyrus DC.; Euphorbiaceæ; (H.-Hartho, Bo.-Kiran, Nep.-Achai); leaves—vermifuge.
Semecarpus anacardium Linn.; Anacardiaceæ; (S.-Bhallatamu, H. & B.-Bhela, Bo.-Biba, M.-Shayrang); externally in rheum., scorpion-sting and leprous nodules, internally in scrofulous affections and nervous debility; Ann. Chem. 1847, 259; Jr. Ind. Inst. Sci. 1925, 129; Jr. Ind. C. S. 1931, 517.[k]
Senecio densiflorus Wall.; Compositæ; (P.-Chitawála); applied to boils.
S. jacobæa Don.; Compositæ; alk.; Pharm. Jr., 1895, Nr. 1331, 535.
S. jacquemontianus Benth. (Kash.-Poshkar); adulterant for kut root.
S. laciniosus W.; officinal in Kashmir; Stewart, Punj. Plants.
S. quinquelobus Hook. (P.-Morta); used in colic.
S. tenuifolius Burm. (P.-Sanggye); officinal in Kashmir.
S. vulgaris Linn.; induces hepatic cirrhosis when administered to animals; alk.; Compt. Rend., 1895, 1120; Bull. Imp. Inst. 1911, 346; Proc. Roy. Soc. 1911, 188.
About fifty-five species of Senecio are uninvestigated.
Serratula anthelmintica Roxb.; Compositæ; see VERNONIA ANTHELMINTICA.†
Sesamum indicum DC.; Pedalineæ; (S., H., B. & Bo.-Til, M.-Yellu-cheddie); used in piles, dysen., scorpion-sting; Mem. Dept. Agri., March, 1907, 1. Nr. 2.
Sesbania aculeata Pers.; Leguminosæ; (S., H. & B.-Jayanti, Bo.-Rán-shewrá, M.-Erra-jiluga); Bull. Imp. Inst. Lond. 1919, 184.
S. ægyptiaca Pers. (H. & B.-Jayanti, Bo.-Jait, M.-Champai); seeds and bark—in diar., excessive menstrual flow and in skin diseases, leaves—in rheum.
S. grandiflora Pers. (S.-Agasta, H. & Bo.-Basna, B.-Bak, M.-Agatti); astrin., tonic, remedy for nasal catarrh.; C. C. 1909, II, 649.
Seseli indicum W. & A.; Umbelliferæ; (S.-Vanayamáni, B.-Banjowán, Bo.-Kirmanji-ajvan); carmin.
Setaria italica Beauv.; Gramineæ; (S., H.-Kangu, B.-Kakni, Bo.-Kangni, M.-Tennai); diur. and astrin., used in rheum.
Shorea robusta Gærtn.; Dipterocarpeæ; (S., H., B. & Bo.-Sal, M.-Kungiliyam); gum—astrin., used in dysen. and scorpion-sting.
S. tumbuggaia Roxb. (H. & B.-Káládámar, M.-Karuppu-dámar); resin—subst. for Burgandy pitch.

Sida acuta Burm.; Malvaceæ; syn. SIDA CARPINIFOLIA Linn.
S. carpinifolia Linn.; (S.-Balá, H.-Bariára, B.-Bon-methi, Bo.-Janglimethi, M.-Vattatirippi); in scorpion-sting, root—diaphor., antipyr., tonic.
S. cordifolia Linn.; (S.-Balá, H.-Kungyi, B.-Brelá, Bo.-Chikana, M.-Chiribenda); root—in nervous and urinary diseases, disorder of blood and bile, in asthma, as cardiac tonic; I. J. M. R., 1930, 467; Jr. Ind. C. S., 1930, 825.*
S. grewioides Guill. & Perr.
S. humilis Willd.; (B.-Junka, M.-Palam-pási); in diar.
S. rhombifolia Linn.; (S.-Atibala, H. & B.-Swet.-berela, M.-Athiballa-chettu); in scorpion-sting.
var. microphylla *Cav.*, obovata *Wall.*, retusa *Linn.*, rhomboidea *Roxb.*, scarbrida *W. & A.*
S. retusa Linn.
S. schimperiana Hochst.
S. spinosa Linn.; (S.-Nágabalá, H.-Gulsakari, B.-Bonmethi, M.-Mayir-mánikkam); roots—used in debility and fever.
Siegesbeckia orientalis Linn.; Compositæ; (M.-Katampam); sialog., tonic, aper., used in skin diseases; cryst. bitter substance, New Commercial Drugs, 1886, 49.
Silybum marianum Gærtn.; Compositeæ; cholag.; tyramin.; Merck's Index, 1902, 341; Biochem. Ztscher. 1922, 402.
Sisymbrium irio Linn.; Cruciferæ; (H.-Khubkáln, Bo.-Khákshi); expect., stim., restor., used in asthma.
S. nasturtium.; (H.-Lootputiah, Ind. Baz.—Seids-huruf); leaves—stim., diur., antiscor.
S. sophia Linn.; subst. for S. IRIS.
Skimmia laureola Hook.; Rutaceæ; (Nep.-Chumlani, P.-Ner); leaves—used in small pox; essen. oil; Schim. Ber. 1926, April, 46; Jr. Soc. Chem. Ind., 1921, 126.†
Smilax aspera Linn.; Liliaceæ; subst. for Indian sarsaparilla.
S. china Linn.; Smilaceæ; (S., H., B. & Bo.-Chobchini, M.-Paringay); aphrodis., sudorific, demulc., used in rheum., saponin; Jr. Prakt. Pharm. 1844, 291. 9. 1033.
S. glabra Roxb.; (H.-Bari-chobchini, B.-Hariná-shuk-chini); used in venereal complaints.
S. lanceæfolia Roxb. (H.-Hindi-chobchini, B.-Gutea sukh-chini); used like SMILAX CHINA.
S. macrophylla Roxb. (H.-Jungli aushbah, B.-Kumarika, Bo.-Guti, M.-Malait-támara); subst. for sarsaparilla.
S. ovalifolia Roxb. (H.-Jangli ush-bah, Bo.-Guti, M.-Malaitamara); subst. for sarsaparilla.
S. pseudo-china Willd.; same as S. CHINA; Chinese Mat. Med.
S. zeylanica Linn. (S.-Vanamadhusnahi, M.-Periyakanni); decoct. of the root given for swellings, abscesses and boils.
Smithia geminiflora Roth.; Leguminosæ; (S.-Lakshmana, M.-Elakanni); used in biliousness, rheum. and ulcers; laxt. and used in sterility in women, removes effects of old age and wrinkles.
Soja hispida Mœnch.; Leguminosæ (Eng.-Soya-bean); diet for diabetics.
Solanum dulcamara Linn.; Solanaceæ; (S.-Kakmachi, P.-Ruba-barik); cardiac tonic, alter., diur., used in skin diseases; glucd. alk., solanine; Arch. Pharm., 1835, 299; 1857, 335; Compt. Rend., 1856, 978; Pharm. Jr., 1902, 160; glucd. dulcamarin; Arch. Pharm., 1875, 289.†
S. ferox Linn. (B.-Ram-begun); berries used medicinally.
S. gracilipes Dcne. (Ind. Baz.-Marghipal); fruit—used in [illegible].

Solanum indicum Linn. (S.-Vrihati, H.-Birhatta, B.-Byakura, Bo.-Kingani, M.-Pappara-mulli); carmin., used in asthma, cough, in scorpion-sting and difficult parturition, aphrodis., cardiac tonic, alk. solanine, solanidine.†

S. lycopersicum Linn.; alk.; Amer. Jr. Pharm., 73, 8.

S. melongena Linn. (S.-Bartaku, H.-Baigun, B.-Begun, Bo.-Baigana, M.-Vankaya); leaves—narcotic, seeds—stim.†

S. nigrum Linn. (S. & B.-Kakmachi, H.-Makoi, Bo.-Mako, M.-Manattakkali); in scorpion-sting; alk. solanine, saponin; Arch. Pharm. 1891, 527; Pharm. Centralh 1892, 712†

S. spirale Roxb. (H.-Mungas kajur, Bagua); root—narcotic, diur.

S. trilobatum Linn. (S.-Alarka, M.-Tudavullay); cardiac tonic, carmin., useful in asthma, chr. febrile affections and difficult parturition.

S. verbascifolium Linn. (Nep.-Dursul, H.-Asheta, M.-Rasagadi-Mánu); alk. solanine, saponin; Jr. Chim. Med. 1825, 517; Pharm. Centralh. 1892, 712.

S. xanthocarpum Schrad. (S. & B.-Kantakari, H.-Kateli, Bo.-Bhuringni, M.-Kandan-kattiri); use same as S. TRILOBATUM.†

Solenanthus Sp. Hk. f. & T. Boragineæ; (P.-Lendi); applied to abscess.

Solidago virga-aurea Linn.; Compositæ; antisep., used for stone in bladder; saponin; Pharm. Centralh., 1925, 424; Amer. Chem. Jr. 1904, 69.

Sonchus arvensis Linn.; Compositæ; (H.-Sahadevi bari, B.-Bon-pálang, M.-Bhangra); root—in jaundice; Monatsh. Chem. 1925, 459; Ann. Chem. 1846, 83.

S. oleraceus Linn. (P.-Dodak, M.-Ratrinta); tonic, febge., galact., used in liver diseases.

Sonneratia acida Linn.; Lythraceæ; (B.-Archaká); fruit—poultice in swellings.

Sophora tomentosa Linn.; Liguminosæ; specific in bilious sickness; alk, Arch. Pharm. 1891, 561; 1894, 444; 1895, 430; Ber. 1890, 3589.

Sopubia delphinifolia G. Don.; Scrophularineæ; (Bo.-Dudháli); astrin., applied to bruises and sores.

Sorghum halpense Pers.; Gramineæ; (H.-Baru, B.-Kala-mucha); rhizome —HCN; ref. see S. VULGARE.

S. saccharatum Pers.; (H. & Bo.-Deo-dhan, M.-Tella-jonna); HCN in sap.; Jr. Amer. C. S., 1903, 55.

S. vulgare Pers.; (S.-Javanala, H., B. & Bo.-Jowar, M.-Cholam); aphrodis.; glucd. dhurin, leaves contain HCN; Proc. Royal Soc. 1902, 153; Chem. News 1902, 301; C. C. 1921, I, 31; Jr. Agri. Res. 1924, 717; J. C. S. 1910, 220; Chem. Ztg. 1911, 1436 (C. C. 1912. I. 583).†

Soymida febrifuga Juss.; Meliaceæ; (S.-Rohuna, H., B. & Bo.-Rohan, M.-Shem marum); astrin., febge.; bitter substance; Arch. Pharm. 1851, 271.

Spatholobus roxburghii Benth.; Leguminosæ. (M.-Plashi-valli); decoct. of the bark—used as a remedy in dropsy, worms, bowel complaints and in snake poison.

Spermacoce hispida Linn.; Rubiaceæ; (S. & H.-Madanaghanti, Bo.-Ghanta-chi-vaji, M.-Nattai-churi); tonic, stim., demulc., alter.

Sphæranthus indicus Linn.; Compositæ; (S.-Munditika, H. & Bo.-Gorakmundi, B.-Murmuria, M.-Kottak); bitter, stomch., stim., used in glandular swellings, urethral discharges and jaundice; essen. oil, alk.; Pharm. Ind., Vol. II, 258; Pharm. Jr. 1884, 985†

Spilanthes acmella Linn.; Compositæ; (Bo.-Pipulka, M.-Vana-mugali); used in toothache and periostites; spilanthol; Jr. Pharm. Soc. Japan, 1922, 460; 1927, 77.

Spilanthes oleracea Jacq. (P.-Pakarmul, B.-Roshunia, Bo.-Akra, M.-Ukra); stim., sialog., used in paralysis of tongue and affections of throat and gums; spilanthol; Arch. Pharm. 1903, 270; Apoth. Ztg. 1908, 947.
Spinacia oleracea Linn.; Chenopodiaceæ; (H. & Bo.-Pálak, B.-Pálang, M.-Vusayley-keeray); in febrile affections, inflam. of lungs and bowel; iodine, lecithin; As, 0,009 mg. in 100 g. leaves; Compt. Rend. 1912, 893; C. C. 1912. I. 1730; 1927, I, 1327; Jr. Biol. Chem., 1920, I.
Spiræa aruncus Linn.; Rosaceæ; HCN-glucd.; Ann. Chem., 1852, 175.
S. lindleyana Wall.; leaves and roots—HCN; Compt. Rend., 1906, 451.
Spondias mangifera Willd.; Anacardiaceæ; (S.-Amrátaka, H., B. & Bo.-Amrá, M.-Mari-manchedi); astrin., arom., demulc., used in dysen.; Chem. Ztg. 1897, 719.
Stachys parviflora Benth.; Labiatæ; (P.-Kirimar); useful in guinea worms.
Statice ægyptica Delile; Plumbagineæ; febge., stomch.; Murray, Drugs of Sind.
Stemodia viscosa Roxb.; Scrophularineæ; (B.-Nukachuni, M.-Bodasarum); demulc.
Stephania hernandifolia Walp.; Memispermaceæ; (S.-Vanatikta, B.-Aknad.); used in diar., dyspep., urinary diseases; saponin; Meded. Lands. Plantent. 1897, 97; 1898, 124.
S. rotunda Lour.; use same as S. HERNANDIFOLIA.
Stephegyne parvifolia Korth.; Rubiaceæ; (H. & Bo.-Kaddam, P.-Kalam, M.-Buta kudambe); given in fever and colic.
Sterculia alata Roxb.; Sterculiaceæ; (M.-Pothondi); seeds—used in Sylhet as a subst. for opium.
S. fœtida Linn.; (H. & Bo.-Janglibadam, M.-Pinari-marum); aper., diaphor., diur.; C. C. 1903, I, 1249; Phil. Jr. Sci. 1915, 105.
S. scaphigera Wall.; used in dysen.
S. urens Roxb. (H. & Bo.-Gulu, M.-Vellay-putali); subst. for tragacanth.
Stereospermum chelonoides DC.; Bignoniaceæ; (H.-Pader, B.-Dharmar, Bo.-Pádel, M.-Padri); cooling, in scorpion-sting; cryst. bitter substance; Meded. Lands. Plantent 1897, 39; 1899, 136.
S. suaveolens DC. (S.-Pátalá, H. & Bo.-Paral, B.-Párul, M.-Pádri); cooling, diur., tonic; ref. same as S. CHELONOIDES.
S. xylocarpum Wight. (Bo.-Kharsing, M.-Vadencarni); subst. for stockholm tar, used in scaly eruptions of skin.
Stipa tortilis Linn.; Gramineæ; HCN-glucd.; Jr. Pharm. Chim., 1908, 6 (542).
Stranvæsia glaucescens Lindl.; Rosaceæ; (Kumaon.-Garmehal); leaves—HCN; Arch. Pharm., 1906, 670.
Streblus asper Linn.; Urticaceæ; (S.-Sákhotaka, H.-Siora, B.-Sheora, Bo.-Kavati, M.-Prayám); used in fever, dysen., diar., antid. to snake-bite: bitter substance; Nederl. Tijdschrft. Pharm., 1896, 204.
Striga orobanchoides Benth.; Scrophularineæ; used in diabetes; Murray, Drugs of Sind.
Strobilanthes auriculatus Nees.; Acanthaceæ; (Santh.-Gada-kalha); leaves—used in intermittent fever.
S. callosus Nees. (Bo.-Karoi); bark—used for fomentation in tenesmus and as external application in parotitis.
S. ciliatus Nees. (Bo.-Karvi); bark—use same as S. CALLOSUS.
Strophanthus dichotomus DC.; Apocynaceæ; leaves, bark and seeds contain strophanthin like tox. glucd.; Meded. Lands Plantent Nr. XXV, 124; C. C., 1905. II. 975.
S. wightianus Wall.; strophanthin; Dragendorff-Heilpflanzen.
Strychnos axillaris Coleb.; Loganiaceæ; alk.
S. bourdilloni Sp. Nova (Brandis.); (M.-Valli-kanjiram); decoct. of the root—applied in rheum., ulcers, elephantiasis, fever and epilepsy.

Strychnos cinnamomifolia Thw.; (M.-Valli-kanjiram); use same as S. BOURDILLONI.
S. colubrina Linn.; (H. & B.-Kuchila-lata, Bo.-Goagarilakei, M.-Naga-musadi); use same as S. NUX VOMICA, brucine; Arch. Pharm., 1892, 401; 1901, 491; Pharm. Jr. 1879, 1013.†
S. gaultheriana Pier.; brucine, strychnine; Arch. Pharm., 1892, 348.
S. ignatii Berg. (H., B. & Bo.-Pipita M.-Kayap-pan kottai); strychnine, brucine.†
S. maingayi Clarke; tox. alk.; Ann. Chim. Pharm., 1897, 385.
S. nux vomica Linn. (S.-Visha-mushti, H.-Kuchla, B.-Kuchila, Bo.-Kajra, M.-Yetti); strychnine, brucine; investigation shows that the alkaloidal content is not altered by long storage in a moist condition. Adulteration of the seeds with S. BLANDA, a non strychnine bearing seed, appears to be the real cause of the reported variation; Quarterly Jr. of Pharmacy & Pharmacology, Dec. 1932.
S. potatorum Linn. (S.-Kátaka, H., B. & Bo.-Nirmali, M. Tetan-kottai); brucine; Arch. Pharm. 1892, 549.
S. rheedei Clarke. (H. & B.-Kuchilalata, M.-Naga-musadi); brucine, strychnine.
S. wallichiana Benth.; traces of alk.; Oestr. Bot. Zeitschr., 1927, 89.
Styrax benzoin Dryand.; Styraceæ; Gum Benzoin; (H., B. & Bo.-Luban, M.-Shambiráni); Perf. Moderne. 1925, 117 & 143.†
S. hookeri Clarke. (Lepcha.-Chanokung).
S. officinale Linn. (B.-Silajit, Bo.-Usturak); stim.
S. polyspermum Clarke.
S. serrulatum Roxb. (B.-Kam-jameva); resin—similar to gum benzoin.
Suæda fruticosa Forsk.; Chenopodiaceæ; (P.-Lunak, Bo.-Morasa); used as poultice for ophthalmia and applied to sores.
Swertia affinis Clarke.; Gentianaceæ; subst. for chiretta.
S. alata Royle. (P.-Hátmul); tonic, febge.
S. angustifolia Ham. (H.-Pahari kiretta); subst. for chiretta.
S. chirata Ham.; (S.-Kirata, H.-Chárayatah, B.-Chiretá, Bo.-Chiraita, M.-Nila-Vembu); bitter, stomch., in scorpion-sting; bitter substance chiratin; ophelic acid; Arch. Pharm. 1869, 213; Pharm. Jr. 1919, 82.*
S. corymbosa Wight.; subst. for chiretta.
S. decussata Nimmo.; (Dec.-Silajit); subst. for true chiretta.
S. paniculata Wall.; (Bo.-Kadavi); subst. for chiretta.
S. perennis Linn.; gentiopicrin; Jr. Pharm. Chim., 1912, 481.
S. purpurascens Wall. (H.-Cheretta); used like chiretta.
Symplocos cratægoides Ham.; Styraceæ; (P.-Lodar, Bo.-Lodh); bark—used in ophthalmia.
S. racemosa Roxb. (S.-Lodhra, H., B. & Bo.-Lodh, M.-Ludduga); astrin., used in scorpion-sting, eye diseases, dysen., dropsy; alk. loturine, colloturine, loturidine; Ber., 1878, 1542; C. C. 1921, I, 292.*†
Synantherias sylvatica Schot.; Aroideæ; (S.-Vajra-kanda); seeds—cure for toothache and gland enlargement.
Syringa emodi Wall.; Oleaceæ; (P.-Sháfri); astrin.; bitter principle.
S. persica Linn.; glucd. syringin; Jr. Pharm. Chim., 1906, 145.

Tabernæmontana coronaria Br.; Apocynaceæ; (S., H., B. & Bo.-Tagar, M.-Nanthia-vatai); anthelm., used for diseases of eye; alk.
T. dichotoma Roxb. (P.-Pilikarbir, M.-Kát-aralie); seeds—narcotic, poisonous, purg., leaves and bark—cath., root and bark—in scorpion-sting.
T. heyneana Wall. (Bo.-Naglkud); use similar to T. CORONARIA.

Tabernæmontana sphærocarpa Blume; bark and seeds contain alk.; Ber., 1890, 3545.

T. wallichiana Steud.; alk.; Ber., 1890, 3545.

Tacca pinnatifida Forst.; Taccaceæ; (Bo.-Diva, M.-Karachunai); root—bitter, useful in dysen.; Pharm. Ztg., 1892, 770.

Tagetes erecta Linn.; Compositæ; (H. & B.-Genda, Bo.-Guljáfari, M.-Banti); alter., used in bleeding piles; essen. oil, colouring matter; Proc. Chem. Soc. 1902, 75; Schim. Ber. 1908. Oct. 147.

Tamarindus indica Linn.; Leguminosæ; (S.-Tintiri, H. & Bo.-Amli, B.-Tentul, M.-Puliyam-pazham); refrig., digest., carmin., laxt., in scorpion-sting; fruit contains trace of oxalic acid; C. C. 1905, II, 1042; 1923, II, 1170.

Tamarix articulata Vahl.; Tamariscineæ. (H.-Lal-jhav, B.-Rakta-jháv, Bo.-Magiya-máin, M.-Shivappu-atru-shavukku); astrin., subst. for galls; C. C. 1928, II, 1412; 1929, I, 1012.

T. dioica Roxb. (H.-Jhau, B.-Laljhau Bo.-Jau); astrin.

T. gallica Linn. (S.-Jhávuka, H. & B.-Jháu, Bo.-Javnu-jhádu, M.-Shiru-shavakku); manna—laxt., expect., subst. for galls; J. C. S., 1898, 374.

Taraktogenos kurzii King; Bixineæ; (H. & Bo.-Chaulmoogra, M.-Niradi-mutu); used in leprosy and many skin diseases; HCN—0,4% in fresh seeds; Proc. Chem. Soc. 1904, 137; J. C. S., 1904, 836, 838, 851; Jr. Amer. C. S., 1925, 2325; 1927, 119; C. C. 1929, II, 1092; Pharm. Weekbl. 1905, 102.*

Taraxacum officinale Wigg.; Compositæ; (P.-Kanphul, Bo.-Bathur); diur., remedy for chr. disorder of liver; bitter substance; Arch. Pharm., 1861, 6; J. C. S. 1912, 2411; 1913, 399; C. C. 1927, I, 2326.

Taverniera nummularia DC.; Leguminosæ; applied to ulcers.

Taxus baccata Linn.; Coniferæ; (H., B. & Bo.-Birmi); carmin., expect., stomch., tonic, in scorpion-sting; alk. taxine; J. C. S. 1902, 874; Z. Physiol. Chem. 1921, 240; Jr. Pharm. Soc. Japan, 1922, 1074.

Tecoma undulata G. Don.; Bignoniaceæ; (H. & Bo.-Rugtrora, P.-Rohira); bark—remedy for syphilis.

Tectona grandis Linn; Verbenaceæ; (S.-Sáka, H. & B.-Segun,, Bo.-Tekku, M.-Tekkumaram); astrin., hepatic, stim., diur., applied in skin diseases; J. C. S. 1887, 868; Ber. 1877, 2234; Ber. Pharm. Ges. 1914, 385.

Tephrosia purpurea Pers.; Leguminosæ; (S.-Sarapunkha, B.-Bon-nil, H. & Bo.-Sarphankha, M.-Kolluk-kay-velai); febge., cholag., diur.; gulcd. rutin; J. C. S., 1910, 1833.

T. villosa Pers. (M.-Vaykkavalai); leaves—in dropsy.

Teramnus labialis Spreng.; Leguminosæ; (S.-Masha-parui, H.-Mash-parui, B.-Mashani, M.-Kattualandu); stomch., febge., used in nerve disease, paralysis and rheum.

Terminalia arjuna W. & A.; Combretaceæ (S. & Bo.-Arjuna, H. & B.-Arjun, M.-Vellai-maruda-maram); cardiac tonic, in scorpion-sting; I. M. G., 1929, 70.*

T. belerica Roxb. (S.-Bahira, H. & B.-Bahera, Bo.-Behaira, M.-Vallai-murdu); astrin., laxt., in scorpion-sting, kernel—narcotic, applied to inflam.

T. catappa Linn. (H. & Bo.-Jangli badam, B.-Bangla badam, M.-Nattu-vadam); astrin., oil subst. for almond oil.

T. chebula Retz. (S. & B.-Haritaki, H.-Harara, Bo.-Hirda, M.-Kaduk-kay-pu); astrin., laxt., alter., in scorpion-sting; Ber. 1909, 353; 1919, 1238; J. C. S. 1897, 1131; Jr. Soc. Chem. Ind. 1903, No. 21.

T. citrina Roxb. (H.-Harira, B.-Haritaki); properties similar to chebulic myrobalans.

T. paniculata Roth. (Bo.-Kindal, M.-Pekarakai); remedy in cholera and opium poisoning.

Terminalia tomentosa Bedd. (H.-Asan, B.-Pia-sal, Bo.-Asna, M.-Kurupu-marutamaram); astrin., used for atonic diar., applied to ulcers.

Teucrium chamædrys Linn.; Labiatæ; (Arab.-Kamazariyus); tonic, diur., sudorific; essen. oil, bitter substance; Merck's Index, 1902, 308.

T. polium. (Arab.-Bulium); essen. oil; Ann. Chim. Appl. 1925, 162.

T. scordium Linn.; amorphous bitter substance; Buchn. Repert. Pharm. 1831, 252.

Thalictrum foliolosum DC.; Ranunculaceæ; (H.-Pinjari, P.-Gurbiáni, Bo.-Mamiran); tonic, aper., febge., good remedy for dyspep.; berberine; Pharm. Ind. Vol. I, 35.

Theobroma cacao *Linn.*; *Sterculiaceæ*; *fat—officinal in Pharmacopœias of India and U. K.*

Thespesia lampas Dalz.; Malvaceæ; (B.-Boukapas, Bo.-Ranbhendi, M.-Ronda-patti); used in gonor. and syphilis; J. C. S. 1909, 1855.

T. populnea Corr. (S.-Parisa, H.-Paras-pipal, B.-Porash, Bo.-Pálas, M.-Purasha-maram); applied to scabies, psoriasis.

Thevetia neriifolia Juss.; Apocynaceæ; (H. & Bo.-Pila-kaner, B.-Kolka-phul, M.-Pachch-ai-alari); poisonous; glucd. thevetin; Pharm. Jr. 1881, 457; Ber. 1882, 253; Arch. Pharm. 1876, 385; Bull. Sc. Pharm. 1923, 81; Jr. Ind. Inst. Sci. 1927, 10 A. 15.*

Thymus serpyllum Linn.; Labiatæ; (H.-Bonajowan, P.-Masho); antisep., anthelm., carmin, used in skin diseases; essen. oil, 0.6%; Arch. Pharm., 1880, 277; 1878, 485.†

T. vulgaris Linn.; Schim. Ber., 1925, 56; 1927, 106; Bull. Imp. Inst. Lond., 1924, 274; Bull. Sc. Pharm., 1923, 201.†

Thysanolæna acarifera Nees.; Gramineæ; (Santh.-Karsar); root—mouth wash in fever.

Tiliacora racemosa Coleb.; Menispermaceæ; (H.-Bágamushada, B.-Tilia-kora, M.-Tiga-mushadi); antid. to snake-bite; alk. tiliacorine; Pharm. Weekbl., 1922, 1381.

Tinospora cordifolia Miers.; Menispermaceæ; (S.-Guduchi, H. & B.-Gulancha, Bo.-Gulwail, M.-Shindil-kodi); antiper., alter., diur., in scorpion-sting; berberine, bitter substance; Pharm. Ind., Vol. I, 56; Bull. Inst. Bot. Buitenzog, 1902, XIV. II.†

T. crispa *Miers.; antiper. in fevers, tonic, alter., diur.*

T. tomentosa Miers.; (S.-Sudarsana, B.-Padma golancha); use same as T. CORDIFOLIA.

Toddalia aculeata Pers.; Rutaceæ; (S.-Kanchana, H.-Kanj, B.-Koda-todali, Bo.-Jun-li-kali-mirchi, M.-Milkaranai); bitter, stomch., tonic, antiper.; essen. oil, berberine; Schim. Ber., 1893, April, 64; J. C. S., 1895, 413; Chem. News, 1895. 71, 207.*

T. bilocularis W. & A.; Rutaceæ; (S.-Krishnaaguru, M.-Devadarom); wood boiled in oil—used in eye and ear diseases, rheum., asthma, decoct. of root—in biliousness.

Torenia asiatica Linn.; Scrophularineæ; (M.-Kákápu); leaves—cure for gonor.

Trachelospermum fragrans Hook.; Apocynaceæ; (Kumaon-Dudhi); subst. for Alstonia scholaris.

Trachydium lehmanni Benth.; Umbelliferæ; (Ind. Baz.-Shekakul).

Trachylobium hornemannianum Heyne.; Leguminosæ; gum copal (Ind. Baz.-Sandarus); astrin., anthelm., diur., emmen., in scorpion-sting.

Tradescantia axillaris Linn.; Commelinaceæ; (H.-Baganella, M.-Gola-gandi); used in tympanitis.

Tragia involucrata Linn.; Euphorbiaceæ; (S.-Vrischikáli, H.-Barhantá, B.-Bichuti, Bo.-Kánchkuri, M.-Kanchuri-vayr); diaphor., alter., diur. in scorpion-sting.

Tragopogon pratense Linn.; Compositæ; As, 0.007 mg. in 100g plant; Compt. Rend., 1912, 893 (C. C., 1912, I. 1730).

Trapa bispinosa Roxb.; Onagraceæ; (B.-Paniphal, H. & M.-Singhara, Bo.-Shingádá); cooling, useful in diar., bilious affections and in scorpion-sting.

Trema orientalis Blume.; Urticaceæ; (S.-Jivanti, M.-Chenkolam); used in epilepsy.

Trewia nudiflora Linn.; Euphorbiaceæ; (S. & H.-Pindára, B.-Pitáli, Bo.-Petári); useful in rheum.; alk.; Pharm. Ind., Vol. III, 295.†

Trianthema decandra Linn.; Ficoideæ; (S.-Punarnavi, H. & B.-Gadabani, M.-Vallai sharunnai); root—aper., used in hepatitis, asthma, orchitis.

T. monogyna Linn. (H.-Lal-sabuni, Bo.-Bishkápra, M.-Sharunnay); cath., abortif, used in amenor.; saponin; Pharm. Ind., Vol. III, 103.

T. pentandra Linn. (P. & Bo.-Bishkáprá); astrin., abortif., in scorpion-sting.

Tribulus alatus Delile.; Zygophylleæ; (H.-Gokhuri-kalan, Bo.-Trikundri); use same as T. TERRESTRIS.

T. terrestris Linn. (S.-Gokshura, H.-Chotagokhru, B.-Gokhuri, Bo.-Lahana-gokhru, M.-Nirunji); diur., tonic, aphrodis., in scorpion-sting.; I. J. M. R. 1929, 377.' †

Trichilia trifoliata Roxb.; Meliaceæ; (M.-Walsura); emmen., emetic, fish poison; saponin; Pharm. Ind., Vol. I, 341.

Trichodesma africanum Br.; Boragineæ; (Bo.-Paburpani); emol., alter., diur.

T. indicum Br. (H.-Chhota kulpha, B.-Choto kulpa, Bo.-Lahána-kalpa, M.-Kazuthai tumbai); cooling, emol., cure for snake-bite; Bull. Imp. Inst. Lond. 1926, 443.

T. zeylanicum Br. (S. & H.-Jhingi, Bo.-Gaozaban); leaves—to make emol. poultice.

Tricholepis glaberrima DC.; Compositæ; (Bo.-Bramhadandi); nerve tonic, aphrodis.

T. montana Dalz. (M.-Utakatara); bitter tonic, diur., used in cough.

T. procumbens Wight. (H. & Bo.-Badavarda, Pers.-Kangarisufeda); aper., stomch., febge., tonic.

Trichosanthes anguina Linn.; Cucurbitaceæ; (S.-Chichinda, H.-Chachinga, B.-Chichinga, Bo.-Pandola, M.-Linga-potla); seeds—cooling.†

T. cordata Roxb. (B.-Bhui-kumra); root—tonic, used in enlargement of spleen and liver.

T. cucumerina Linn. (S.-Patola, H.-Jangli-chichonda, B.-Bonpatol, Bo.-Ránparul., M.-Pudel), febge., laxt., aper., alter., tonic.

T. dioica Roxb. (S.-Patola, H.-Parvar, B.-Potal, Bo.-Potala, M.-Kombu-pudalai); leaves—tonic, febge., fruit of the bitter variety—in scorpion-sting.

T. nervifolia Linn. (H.-Parvar, B.-Patol, M.-Kombu-pudalai); use same as T. DIOICA.

T. palmata Roxb. (S.-Mahákál, H.-Lal-indrayan, B.-Mákal, Bo.-Kaundal, M.-Korattai); useful in asthma and lung diseases; bitter substance, Pharm. Ind., Vol. II, 72; Pharm. Jr. 1890, 169; Pharm. Centralh 1892, 944.

Trifolium indicum Linn.; Leguminosæ; see MELILOTUS PARVIFLORA.

T. pratense Linn.; (P.-Trepatra); glucd. trifolin, isotrifolin; J. C. S., 1910, 232; As, 0.012 mg. in 100g. fresh plant and 0.037 mg. in dry; Compt. Rend., 1914, 268 (C. C., 1914. II. 885).

T. repens Linn.; glucd.; Chem. News. 1911, 276; Pharm. Jr. 1911, 881.

Triglochin maritima Linn.; Naiadaceæ; HCN-glucd.; Pharm. Weekbl., 1908, 1167.

T. palustris Linn.; HCN; Pharm. Weekbl., 1908, 1167.

Trigonella fœnum-græceum Linn.; Leguminosæ; (H., B. & Bo.-Methi, M.-Vendayam); carmin, tonic, aphrodis.; alk. trigonelline, Ber., 1885, 2518; Arch. Pharm., 1887, 985; essen. oil; Pharm. Ztg., 1903, 58; Saponin; Jr. Pharm. Chim., 1919, 183; 1919, 86; Compt. Rend. 1926, 994.†

T. occulta Delile.; seeds—used in dysen.

T. uncata Boiss. (Ind.-Baz.—Iktil-el-malik); narcotic, paralyses heart.†

Triticum sativum Lam.; Gramineæ; (S.-Godhum, H.-Gehun, Bo.-Gam, Bo.-Gahu, M.-Godumai); As. 0,03 mg. in 1 kg. corn; Pharm. Weekbl. 1921, 1482 (C. C. 1922. II. 113).

Triumfetta rhomboidea Jacq.; Tiliaceæ; (H.-Chikti, B.-Bun-okra, M.-Aadai-otti); mucil., demulc., astrin., promotes parturition.

Turræa villosa Benn.; Meliaceæ; (Bo.-Kapur bhendi); applied to fistulas and used in black leprosy.

Tussilago farfara Linn.; Compositæ; (P.-Wátpan, Ind. Baz.-Fanjium); used in chest complaints; bitter glued.; Amer. Jr. Pharm. 1887, 340; Arch. Pharm. 1924, 281; Pharm. Monatsh. 1924, 25.

Tylophora asthmatica W. & A.; Asclepiadeæ; (H. & B.-Antamul, Bo.-Anthamul, M.-Náy-pálai); subst. for ipecacuanha; alk. tylophorine; Bull. Pharm., 1891, 211; Merck's Index, 1927, 471.†

T. fasciculata Ham.; (Bo.-Bhui-dari); poison for rats; alk.; Pharm. Ind., Vol. III, 441.

T. tenuis Blume.; Asclepiadeæ; (M.-Nanjaruppan); decoct. antid. to arsenic poison and snake poison, cures perspiration, urticaria and small pox.

Typha angustifolia Linn.; Typhaceæ; (S.-Eraka, H.-Pater, B.-Hogla, Bo.-Rámbána, M.-Jammu-gaddi); refrig., aphrodis., in dysuria; Chem. Ztg. 1896, 461.

Typhonium trilobatum Schot.; Aroideæ; (B.-Ghet-kachu, M.-Karunaik-kizhangu); stim., used for piles and snake-bites.

Ulmus campestris Linn.; Urticaceæ; leaves—Ba; Chem. News. 1916, 62.

Uncaria gambier Roxb.; Rubiaceæ; (S.-Khadir, H.-Kathkutha, B.-Khayer Bo.-Chinai-katha, M.-Ankudu-kurra); astrin.; catechu, tannic acid, catechin; J. C. S., 1897, 1131; 1902, 1160; 1905, 398.†

Unona narum Dun.; Anonaceæ; (Bo.-Gunamanijhad, M.-Narumpanal); cholag., used in rheum., fever, erysipelas; essen. oil.

Uraria lagopoides DC.; Leguminosæ; (S.-Prishniparni, H.-Pithvan, B.-Chákuliá, Bo.-Dowla, M.-Kola-ponna); alter., tonic, abortif, in catarrh. and scorpion-sting.

U. picta Desv. (H.-Dábrá, B.-Sankarjata, Bo.-Krishniparni); antid. to snake-bite.

Urena lobata Linn.; Malvaceæ (H.-Lotloti, B.-Bonokra, Bo.-Vana-bhenda) applied in lumbago and rheum.; urease; Biochem. Jr., 1914, 449.

U. repanda Roxb. (Santh.-Sikuar); cure for hydrophobia.

U. sinuata Linn. (H.-Lotloti, B.-Kunjia Bo.-Tapkote, M.-piliya-mankena) root—applied for lumbago.

Urginea indica Kunth; Liliaceæ; (S.-Vana-palandam, H. & B.-Jangli-piyaz, Bo.-Jangli-kanda, M.-Nari-vengáyam); cardiac stim., diur.; Pharm. Ind. II, 477; Ind. Jr. Med. Phy. Sc., 1838, 9.*

Urtica dioica Linn.; Urticaceæ; (H. & P.-Bichu); used in nephritis, hæmaturia, menor.; lecithin; Z. Physiol. Chem. 1919, 165; Pharm. Centralh., 1889, 609.

U. parviflora Roxb.; (M.-Anachoriyanom); decoct. given in fevers.

Urticularia bifida Linn.; Lentibularieæ; (Santh.-Arak-Jháwár); used in urinary diseases.

Uvaria narum Wall.; Anonaceæ; (Malay.-Narum-panel); root—used medicinally.

Valeriana brunoniana W. & A.; Valerianeæ; subst. for valerian; essen. oil.
V. hardwickii Wall. (H. & B.-Taggar Bo.-Taggar-ganthoda); subst. for valerian; essen. oil.
V. jatamansi DC. see NARDOSTACHYS JATAMANSIII.
V. officinalis Linn. (Bo.-Káláválа); in hysteria, shell shock, neurosis; essen. oil, glucd., alk.; Apoth. Ztg. 1891, 21; Compt. Rend. 1907, 154; 1921, 1059; 1893, 1096; Schim. Ber. 1918, 7; Jr. Amer. C. S. 1912, 67; Pharm. Ind. II. 237; Jr. Pharm. Soc. Japan 1907, 355; 1926, 75.
V. wallichii DC. (S.-Tagara, H. & B.-Tagar, Bo.-Tagar-ganthoda); used in scorpion-sting, neurosis and epilepsy; Pharm. Jr. 1925, 122; Schim. Ber. 1922, 8.

The following species of Valeriana are uninvestigated:—
V. dioica *Linn.*, V. elegans *Clarke.*, V. hookeriana *W. & A.*, V. jaeschkei *Clarke.*, V. leschenaultii *DC.*, V. moonii *Arn.*, V. pyrolæfolia *Dcne.*, V. roylei *Klotz.*, V. stracheyi *Clarke.*

Vallaris heynei Spreng.; Apocynaceæ; (S.-Bhadra valli, H. & B.-Rámsar, M.-putta-podara-ejárála); used in wounds and sores.
V. pergulana Burm.; tox., heart poison; glucd.; Bull. Inst. Bot. Buitenzorg., 1902, 32.
Vallisneria spiralis Linn.; Hydrocharideæ; (H.-Sáwala, M.-Punatsu); stomch., used in leucor.
Vanda roxburghii Br., Orchideæ; (S., H., B. & Bo.-Rásná, M.-Knapachettu); useful in nerve diseases, rheum., in scorpion-sting; alk.; Pharm. Ind. Vol. III, 294.†
V. spathulata Spreng.; use same as V. ROXBURGHII.
Vandellia erecta Benth.; Scrophularineæ, (Bo.-Vakapuspi); remedy for gonor. and biliousness.
V. pedunculata Benth. (Bo.-Gadagvel); use same as V. ROXBURGHII.
Vangueria spinosa Roxb.; Rubiaceæ; (S.-pindituka, H. & B.-Moyna, Bo.-Alu, M.-Pedda-manga); refrig., cholag., in scorpion-sting.
Vateria indica Linn.; Dipterocarpeæ; (S.-Ajakarua, H.-Safed damar, B.-Chundrus, Bo.-Rál, M.-Vellai-kunrikam); seeds—in chr. rheum.; damar resin; Jr. Soc. Chem. Ind. 1898, 991.
Ventilago madraspatana Gærtn. (S.-Raktavalli, H.-Pitti, B.-Rakta pita, Bo.-Lokandi, M.-Pappili-chakka); carmin., stomch., tonic, used in skin diseases; trihydroxymethyl-anthranolmonomethylether; emodinmonomethyl ether; J. C. S., 1894, 943.†
Verbascum thapsus Linn.; Scrophularineæ; (P.-Bontamaku, H.-Gidartamáku); demulc., diur., anodyne, antisp., alter., fish poison; bitter substance, saponin; Amer. Jr. Pharm. 1890, 71; Arch. Pharm. 1902, 57; 1905, 247; Pharm. Centralh. 1925, 4.†
Verbena officinalis Linn.; Verbenaceæ; (P.-Pamukh); febge., tonic, useful in nerve complaints and amenor.; glucd. verbenalin; Jr. Pharm. Chim., 1908, 49; Arch. Pharm. 1908, 272.
Vernonia anthelmintica Willd.; Compositæ; (S., H. & B.-Somaraj, Bo.-Kalijiri, M.-Kattu-Shiragam); anthelm., in scorpion-sting; Jr. Soc. Chem. Ind. 1910, 1428.†
V. cinerea Less. (S. & H.-Sahadevi, B.-Kukseem, M.-Naichette, Bo.-Moti-sodori); febge., diaphor., in scorpion-sting; remedy for spasm of bladder.
Veronica arvensis Linn.; Scrophularineæ; glucd. rhinanthin (aucubin); Bull. Soc. Chim. Biol., 1924, 665.

Veronica beccabunga Linn.; diur., antiscor.; glucd. aucubin; Bull. Soc. Chim. Biol. 1924, 665.†

V. hederæfolia Linn.; glucd. rhinanthin (aucubin); Bull. Soc. Chim. Biol., 1922, 568.

Viburnum fœtidum Wall.; Caprifoliaceæ; (S.-Shirporna-jaya, Bo.-Nar-*vela); leaves—used in menor.*; essen. oil, cryst. alk.; Pharm. Ind. Vol. II, 168.

Vicia faba Linn.; Leguminosæ; (H.-Bakla); shoots—efficacious in rousing a drunkard from stupor; As, 0,02 mg. in 100 g. seeds; Compt. Rend. 1912, 893 (C. C. 1912, I. 1730); 0,304% PbO in plant ash.

V. hirsuta Koch.; seeds—HCN; C. C., 1900, I. 208.

V. sativa Linn.; var. angustifolia Roth.; Leguminosæ; (H.-Ankra, B.-Ankari); glucd. vicin; seeds—HCN; Flückiger, Pharmacogn., 1891, 1012; Ber., 1896, 2108; Z. Physiol. Chem., 1892, 193; Pharm. Act. Helv. 1928, 31; As, 20 mg. in 100g. fresh plant and 54 mg. in dry; Compt. Rend., 1914, 268 (C. C., 1914. II. 885).

Vigna catiang Endl.; Leguminosæ; (S.-Rájamásha, H.-Lobiá, B.-Barbati, Bo.-Lobeh, M.-Caramunny-pyre); diur.

Vinca pusilla Murr.; Apocynaceæ; (S.-Sangkha-phuli, M.-Kapa-vila); *used in lumbago; alk; Meded. Lands, Plantent. 1899, 49.*

V. rosea Linn. (P.-Rattanjot Bo.-shada-phul, M.-Billa-ganneru); leaves—applied to wasp-sting; alk.—heart poison; Meded. Lands. Plantent. 1899, 49.

Viola cinerea Boiss.; Violaceæ· (P. & Bo.-Banafsha); use same as V. ODORATA

V. odorata Linn. (H. & Bo.-Banapsa, B.-Banosa M.-Vayilettu); flowers—astrin., demulc., diaphor., diur., used in biliousness and lung troubles; glucd., methyl salicyclic ester; Schim. Ber., 1926, 125; 1929, 109; Arch. Pharm., 1882, 378; Amer. Jr. Pharm. 1909, 181; Pharm. Centralh. 1922, 577.†

V. serpens Wall. (H.-Banafsha); used in bilious and pulmonary affections.

V. tricolar Linn.; glucd.; J. C. S., 1897, 1134; Ber., 1883, 1685.

Viscum album Linn.; Loranthaceæ; (H.-Bhanga, Ind. Baz.-Kiss-miss, P.-Kahbang); tonic, antisp., emetic, purg., narcotic, used in hæmor.; As; Compt. Rend. 1912, 291; C. C. 1912, II. 1291; Compt. Rend. 1907, 941; 1912, 291; C. C. 1918, I. 555.†

V. articulatum Burm. (H.-Pudu, Santh.-Katkomjanga); given in fever with aching limbs.

V. monoicum Roxb. (H.-Kuchle-ka-malang, M.-Pulluri); subst. for Nux vomica, poisonous; Jr. de Pharm. 1860, 113.

V. orientale Willd. (H.-Banda, M.-Sundara Bandinika); used medicinally.

Vitex glabrata Br. (B.-Goda, Bo.-sheras, M.-Luki); bark & root—astrin.

V. leucoxylon Linn.; Verbanaceæ; (M.-Mylellu); bark and root—astrin., root—in intermittent fever, leaves—smoked in catarrh and headache, fruit—as vermifuge.†

V. negundo Linn. (S. & H.-Nirgundhi, B.-Nishindá, Bo.-Nirgundi, M.-Nirnochchi); in scorpion-sting, alter., arom., expect., febge., tonic; alk.; Pharm. Ind. Vol. III, 72; Meded. Lands. Plantent. 1900, 31.†

V. peduncularis Wall. (H.-Nagbail B.-Goda M.-Navaladi); formerly subst. for quinine.*

V. trifolia Linn. (S.-Surasa-vrikshaha, H.-Páni-ki-sanbhálu, B.-Pani-samálu, M.-Nirnochchi); use same as V. NEGUNDO; essen. oil, alk.; Schim. Ber. 1894, Oct. 74; Meded. Lands. Plantent. 1900, 31.; Jr. Soc. Chem. Ind. 1921, 411.†

Vitis adnata Wall.; Ampelideæ; (Bo.-Kole-zán, M.-Kokkitayáalu); diur., alter.

V. araneosa Dalz. (H.-Kauraj, Bo.-Chamar-muli); cooling, astrin.

Vitis carnosa Wall. (H.-Amal-bel, B.-Amal-lata, Bo.-Ambat-bit, M.-Kuru-dinna); applied to boils.

V. indica Linn. (H.-Jangli-angur, B.-Amluka Bo.-Randraksha, M.-Shembara-valli); alter., diur.

V. latifolia Roxb. (B.-Govila, M.-Bedisativa); alter., diur.

V. pallida W. & A.; (M.-Chunnampuvalli); used in rheum.

V. pedata Vahl. (S.-Godhápadi, B.-Goalilata Bo.-Gorpadvel, M.-Edakula); leaves—astrin., refrig., used for ulcers.

V. quadrangularis Wall. (S.-Asthisanhara, H. & B.-Harjora, Bo.-Harsankar, M.-Pirandai); alter., stomch., in irregular menstruation, root—used in fracture of bones.

V. setosa Wall. (H.-Harmel, Bo.-Khaj-goli-cha-vel, M.-Puli-perandail); used in indolent tumours and in guinea worms.

V. tomentosa Heyne. (Santh.-Ghoralidi, M.-Atukula-baddu); used for swellings.

V. vinifera Linn. (S.-Drakshya, H. & B.-Angur, Bo.-Drákh M.-Drakshapondu); demulc., laxt., stomch., in scorpion-sting, useful in wasting diseases; As—0,05 mg. in 100 ccm. fruit juice; Arbeit Kaiserl. Gesundheitsamt, 1909, 304; (C. C. 1929. II. 1085); oxalic acid in unripe fruits; Ber. 1876, 982.

Volutarella divaricata Benth.; Compositæ; Ind. Baz.-Badaward; tonic, aper., febge.; alk.; Pharm. Ind. Vol. II, 307.

Wagatea spicata Dalz.; Leguminosæ; (M. & Bo.-Vagati); bark—in skin diseases, root—in pneumonia.

Walsura piscidia Roxb.; Meliaceæ; (Bo. & M.-Walsura); stim., expect., emmen., emetic., used in skin diseases, fish poison.; saponin.; Pharm. Ind. Vol. I, 341; Meded. Lands. Plantent. 1900, 31.†

Webera corymbosa Willd.; Rubiaceæ; (M.-Kura); leaves—used in skin diseases.

Wedelia calendulacea Less.; Compositæ; (S.-Pitabhringi, H. & B.-Bhangra, Bo.-Pivala-bhangra, M.-Postaley-kaiantagerai); leaves—in cough and in skin diseases.

Wikstroemia indica C. A. Mey.; Thymelæaceæ.

Withania coagulans Dunal.; Solanaceæ; (H.-Akri, B.-Asvagandá, Bo.-Káknaj M.-Amukkura); emetic., alter., diur., coagulates milk; Jr. Pharm. Chim., 1885, 563; Proc. Roy. Soc. 1883, 55; Pharm. Jr. 1883, 588; 1884, 506.†

W. somnifera Dunal. (S., B. & Bo.-Ashwagandha, H.-Asgandh, M.-Amkulang-kalang); used in rheum., sanile debility, tonic, astrin., aphrodis., in scorpion-sting; alk.; J. C. S. 1911, 490; Arch. Farm. Sperim. 1924, 151.†

Woodfordia floribunda Salisb.; Lythraceæ; (S.-Dhataki, H. & B.-Dhai. Bo.-Dhauri, M.-Jargi); astrin., used in dysen., menor.

Wrightia antidysenterica Grah.; Apocynaceæ; see HOLARRHENA ANTIDYSENTERICA.

W. tinctoria Br. (S.-Asita kutanja, H.-Mitha indarjou, B.-Indrajav., Bo.-Kálakado, M.-Vetpála virai); astrin., stomch., tonic, febge.; indican; Ber. 1879, 2311; Chem. News, 1878, 223.†

W. tomentosa Rœm.; Apocyanaceæ; (M.-Thonthapala); used in snake-bite an scorpion-sting.

Xanthium strumarium Linn.; Compositæ; (S.-Arishta, H.-Chhota-gokru B.-Bon-okra, Bo.-shankeshvara; M.-Marlu-mutta); diaphor., sedative, sudorific, sialog., in scorpion-sting; glucd. xanthostrumarin, oxalic acid; Apoth. Ztg. 1891, 133; Ber. 1881, 2587.†

Ximenia americana Willd.; Olacineæ; used as a subst. for sandalwood; C. C., 1913, I, 940; 1917, II, 303.

Xylia dolabriformis Benth.; Leguminosæ; (S.-Scimsapa, M.-Irul); decoct. of the bark—used in worms, leprosy, vomiting, diar., gonor., ulcers; *oil from seeds—in rheum., piles and leprosy.*

Xyris anceps Lamk.; Xyrideæ; (M.-Kochelachi-pullu), leaves—boiled in oil—used as a remedy in itches, leprosy and skin diseases.

X. indica Linn.; Xyrideæ; (S.-Dadumari, H.—Dábi-dulea, B.-China ghas); cure for ringworm.

Yeast Toddy. (H. & Dec.-Sendhi, M.-Kallu); poultice applied to gangrenous ulcerations.

Yucca gloriosa Linn.; Liliaceæ; fruit—purg., root—detergent.

Zanonia indica Linn.; Cucurbitaceæ (S.-Dirghapattra, H.-Chirpoti Bo.-chiraputi, M.-Penarvalli); aper., antisp., beneficial in asthma and *cough, antid. to venomous bites.*

Zanthoxylum acanthopodium DC.; Rutaceæ; (H.-Tumra, B.-Tambul); use same as Z. ALATUM; essen. oil; linalool, dipentene, cinnamic methyl ester; Ind. For. Rec., 1922, 111.†

Z. alatum Roxb. (S.-Tumburu, H.-Tejmal, B.-Nepali dhania); arom., tonic, in fever, dyspep., cholera; Ind. For. Rec., 1922, 111.

Z. budrunga Wall. (S.-Tinaburu, H.-Budrung, B.-Tambul, M.-Retsa-maram); astrin., stim., stomch.; alk. 0.24%; Arch. Pharm., 1919, 260; Ind. For. Rec., 1922, 111.†

Z. hamiltonianum Wall. (Nep.-Purpuray timur); use same as Z. ALATUM.

Z. ovalifolium Wight.; use same as Z. ALATUM; essen. oil; Ind. For. Rec., 1924, 12; Chem. & Drug., 1925, 457.

Z. oxyphyllum Edgw. (Nep.-Timur); use same as Z. ALATUM.

Z. rhetsa DC. (Bo.-Tessul M.-Rhetsa-maram); stim., astrin., stomch., arom.; essen. oil; Jr. Ind. Inst. Sci., 1925, 143.

Z. triphyllum Wight.; use same as Z. RHETSA.

Zataria multiflora Boiss.; Labiatæ; (Ind. Baz.-Saatar); arom., stim., diaphor.; arom. essen. oil; Pharm. Ind. Vol. III, 115.

Zea mays Linn.; Gramineæ; (S.-Yavanala, H. & B.-Bhutta, Bo.-Makai M.-Makká-scholam); stigmas—diur., used in diseases of bladder; As—30 mg. in 100 g. fresh corn; Compt. Rend. 1914, 268 (C. C. 1914, II, 885).

Zehneria hookeriana Arn.; Cucurbitaceæ; (C. P.-Ban-kudri); used in fever and diar.

Z. umbellata Thw. (S.-Gumthi, H.-Tarali, B.-Kundari Bo.-Gametta, M.-Tid-danda); stim., demulc., root—in spermatorrhœa.

Zeuxine sulcata Lindl.; Orchideæ; (B.-Shwet-huli); locally used as salep.

Zingiber casumunar Roxb.; Scitamineæ; (S.-Bon-adraka, H. & B.-Bon-ádá Bo.-Nisan, M.-karu-allamu); use same as Z. OFFICINALIS; essen. oil; Pharm. Ind. Vol. III, 427.

Z. officinale Rosc. (S.-Adrakam, H.-Adrak, B.-Ada, M.-Inji); carmin., in scorpion-sting; K-oxalate; Pharm. Jr. Trans., 1892, 802; Schim. Ber., 1905, Oct. 34; Arch. Pharm. 1882, 372; Jr. Ind. 1928, 251; J. C. S., 1917, 769.*

Z. zerumbet Smith. (S.-Sthulagranthi, H. & B.-Mohabari bach); use same as Z. OFFICINALIS.

Ziziphora tenuior Linn.; Labiatæ; (Ind. Baz.-Mishki-i-taramashia); expect.; aphrodis.; essen. oil; C. C., 1927, 1311.

Zizyphus glabrata Heyne.; Rhamineæ; (S.-Vatadalla, M.-Karukattá); used in cachexia and venerial diseases.
Z. jujuba Lamk. (S.-Badari, H.-Baer, B.-Kul, Bo.-Bor, M.-Elandap); astrin., stomch., in scorpion-sting.†
Z. numularia W. & A. (S.-Bolakapriya, H.-Jarberi, M.-Parpalli-gidda); cooling, astrin., used in bilious affections.
Z. œnoplia Mills. (S.-Srigálakoli, H.-Makai, B.-Siákul, M.-Paragi); heals fresh wounds.
Z. rugosa Lamk. (H.-Dhaura, Bo.-Turan); flowers—used in menor.
Z. vulgaris Lamk. (S.-Soubira, H.-Kandiari. Bo.-Unnáb); fruits—demulc., expect.
Zornia diphylla Pers.; Leguminosæ; (Santh.-Tandi-jhapni, M.-Nelam. mari) roots—induce sleep in children.
Zygophyllum simplex Linn.; Zygophylleæ; (P. & Bo.-Alethi); leaves—used in ophthalmia.

SECTION II

INORGANIC PRODUCTS

Used in the Indigenous Medicine

Acidum arseniosum (S.-Sankhavisha, H.-Sankhya); stomch., nerve tonic, alter., antiper., cardiac, respiratory, intestinal and sexual stim.
Acidum hydrochloridum (M.-Ooppootravagum); stomch., tonic.
Adamas—Diamond (S.-Heeraka, H.-Heera); stim., tonic.
Akakiya—A red stone; used as a tonic; said to contain iron.
Alkaline ashes—Amongst these may be mentioned pearl ash or alkaline earth, barilla, kelp (bromine and iodine ash).
Alumen—Alum (S.-Spatikari, H.-Phitkari); astrin., caustic, haemostatic. antisep.
Alumen exsiccatum—Burnt alum; astrin., caustic, checks unhealthy granulations, used in ulcers.
Aluminii silicas—*Felspar (H.-Sufaid mitti, Bo.-Khadu, M.-Namon)*; used as dusting powder.
Ammonii chloridum (S.-Navasara, H.-Navasadara), alter., expect., cholag., purg., useful in fever, spleen, liver, etc.
Antimonii sulphidum—Kermes mineral (S.-Srotonjana, H.-Anjan); used for eye diseases.
Argentum—Silver (S.-Rajata); tonic, stim., aphrodis., used for ulcers.
Arsenii disulphidum or **Arsenicum rubrum**—Realgar (S.-Manashila, H.-Lal haratal); alter., febge., tonic, given in cough, asthma and skin disease.
Arsenii trisulphidum—Orpiment (S., B. & Bo.-Haritala); alter., febge., emmen.
Asbestos (Bo.-Shakha palita); applied to ulcers.
Asphaltum (S.-Silajit, H., B. & Bo.-Silajita); antisep., anodyne, tonic, expect., diur., used in diabetes.
Aurum—Gold (S.-Suvarna, H. & B.-Sona); nerve tonic, aphrodis., emmen., alter.

Barilla; see SODA CARBONAS IMPURA.
Borax (S.-Tunkana, H. & B.-Sohaga); diur., emmen., astrin., antacid, local sedative, antisep.

Calcii carbonas—Chalk, Marble (H.-Vilati-chuna); used in dyspep., acidity, gout, rickets, externally desiccant, absorbent and antacid.
Calcii hydras—Slaked lime; in diar., chr. dysen., vomiting, scrofula, in washing ulcers, burns and scalds.
Calcii sulphas—Gypsum, Alabaster (S.-Sanjirahat, H.-Sufed pathar); used in fracture and on swollen parts, internally as astrin. and antacid.
Calcium oxide—Quick lime (S.-Sudha, Shudhakshara, H.-Kali-ka-chuna); antacid, in painful and gouty joints, ringworm and as depilatory, in jaundice, acidosis, urinary trouble, enlarged glands.
Carbo ligni—Wood charcoal (H.-Lakrika-koyelah); used in dyspep., diar., dysen., typhoid fever.
Clay (S.-Krishnamritrika, H.-Chiknimati); used in dyspep., leucor., to relieve bleeding from internal organs.
Cupri sulphas—Blue vitriol (S.-Sasyaka, Tutta, H.-Nila thotha); astrin., emetic, antisep., externally stim., styptic, caustic.

Cuprum—Copper (S.-Támra, H.-Támbá); astrin., sedative, alter., antisep., emetic, purg., externally in piles, leprosy, skin diseases and ozœna.

Ferri sulphas—Green vitriol (S.-Kasisa, H.-Hara-tutia); hæmatinic, tonic, astrin., externally in skin diseases.

Ferroso-ferric oxide or **Ferri peroxidum rubrum**—Iron rust (S.-Manduram H.-Lohaka); in asthma, general debility, fever and heart disease.

Ferrum—Iron (S.-Lauha, H.-Loha); alter., astrin, tonic, restor.

Ferrum sulphuratum—Iron pyrites (S.-Swarnamakshika, H. & Bo.-Sonamukhi); tonic, alter., useful in anæmia, leucor., urinary diseases, ascites, anasarca, prurigo, eye diseases.

Gopichandan (S.-Shoraktri, H.-Panisoka); used as dusting powder.

Gypsum selenite—Plaster of Paris (H.-Kulnar); cooling, given as gruel in fever.

Hydrargyrum—Mercury (S.-Párada, H.-Párá); tonic, alter., purg., cholag., antiphl., antisep., sialog.

Jade (H.-Yashm); liquor—drunk from a jade or agate cup is supposed to allay palpitation of heart.

Kaolinum—China clay (B.-Gainika); for cholera, dysen., diar., septic wounds.

Lapis lazuli (H.-Lajward, Bo.-Rajavaral); astrin., refrig., externally applied to ulcers; ultramarines.

Magnesia: laxt., alter., aphrodis.

Magnesii disilicas—Serpentine; used for diseases of liver.

Mica—Talc (S.-Abhra, H.-Avrak, M.-Appracam); general tonic, alter., aphrodis., restor.

Orpiment: see ARSENII TRISULPHIDUM.

Phosphorus: stim., powerful irrt. poison.

Plumbi carbonas—White lead (H.-Sufeda, M.-Velliyya); locally sedative, astrin.

Plumbi oxidum—Litharge (H.-Murdosing); astrin., cooling, insecticide.

Plumbi oxidum rubrum—Red lead (S.-Raktanag, B. & Bo.-Sindur); used in skin diseases.

Plumbi sulphuratm—Galena (S.-Anjana, H.-Surma); cosmetic for eyes.

Plumbum—Lead (S.-Seesaka, H.-Sisa); astrin., diur., anthelm., externally sedative.

Potasii carbonas (S.-Yavakshara, H.-Javakhar); stomch., laxt., diur., antacid., resol., alter.

Potasii nitras—Saltpetre (S.-Saindhava, H. & B.-Sora); refrig., diur.

Realgar: see ARSENIC DISULPHIDE.

Saline earths:—
- **Javakhara**—Potash carbonate impure.
- **Navasagara**—Ammonium chloride.
- **Papadkhar**—Pearl ash.
- **Sajikhara**—Carbonate of soda.
- **Shorakhar**—Saltpetre.
- **Tankan khar**—Borax.

Saline substances:—
- **Saindhava**—Rocksalt.
- **Samudra**: bitter and laxt.
- **Vit lavana** (S.-Krishna lavana, H.-Padelon); carmin., aper., tonic, stomch.
- **Sauvarchala** (H.-Sonchal, Kala-nimak); stomch., digest., purg., demulc.
- **Romaka** (H.-Savaramith); laxt., diur.
- **Audbhid**: in the composition of 'pancha-lavana'; principally sulphate of soda.
- **Gutika**: stomch., digest., laxt.
- **Pansuja** or **Ushasuta**: demulc., stim. stomch., laxt.

Silicate of alumina, lime and oxide of iron (H.-Gill); use like 'multani-mati.'

Silicate of alumina, magnesia and oxide of iron (H.-Gherumitti); refrig., astrin., absorb, antisep.

Silicate of alumina and oxide of iron (S.-Gairika, H.-Gerumati); for relieving bleeding from internal organs.

Silicate of lime (H.-Hijrata hau); cooling, demulc., externally in skin diseases.

Silicate of magnesia—Soap stone (H.-Singe jerahata); astrin., desiccant, styptic, internally in dysen., diar., menor., leucor.

Silicate of magnesia and iron—Serpent stone (S.-Gorochana, H.-Pedaru bazara); nerve tonic, astrin.

Silicum—Silicon; used both internally and externally.

Soda carbonas impura (S.-Sarjikakshara, H.-Sajjikhar); antacid, alter., diur.

Sodii chloridum—Common salt (S.-Lavana, H.-Nimak); antisep., antiper., anthelm.

Sodii chloridum impura—Rocksalt; (S.-Saindhava, H.-Sedhalon); carmin., stomch., digest., cath., emetic.

Sodii fluosilicas; antisep., anthelm., deod., styptic., disinfectant.

Stannum—Tin (S.-Vanga, H.-Rang); in diseases of the genito-urinary organs, blood and lungs.

Stannic sulphidum—Mosaic gold (S.-Svarna vanga); in complaints of generative organs of both male and female.

Sulphur (S.-Gandhaka, H.-Gandak); bitter, increases bile, laxt., alter., diur., insecticide.

Zincum—Zinc (S.-Yashada, H.-Jasta); in eye diseases, debility, urinary disorders, asthma.

Zinci carbonas—Calamine (S.-Kharpara, H.-Kala khaparo); nerve tonic, alter., used in syphilis, scrofula and skin diseases.

Zinci oxidum—White zinc (H.-Putty); externally as a mild, soothing astrin., internally as a nerve tonic, sedative, antisp., astrin.

SECTION III

ANIMAL PRODUCTS

Used in the Indigenous Medicine

Achatina fulica.—Land snail (Bo.-Nakhala); shell—used for preparing medicated oil.

Acipenser huso Linn. or **A. Stellatus**—A fish from which Isinglass is manufactured. (H.-Machhika-siras, Bo.-Aisinglasa, M.-Minvajaram); nutri., demulc., emol., given in chr. diar.; similar to albumen, contains pure gelatin.

Acridotheres ginginianus Lath.—A bird (S.-Atipakshi, Saral pakhi, B.-Gang-salik, Ram-salik, Bo.-Bagali-pakshina); flesh—cardiac stim., beneficial in 'vitiated wind and cough.'

Adeps—Lard. (B.-Charbee); for ointments; contains olein, palmitin, margarin, stearin.

Adeps lanæ anhydrosus—Anhydrous wool fat; contains cholesterin.

Adeps lanæ hydrosus—Hydrous wool fat; emol.; contains lanolin; cholesterin, palmitic, stearic, oleic and valerianic acids.

Agama agilis—Sand lizard (Bo.-Sarado); ash—used as nerve tonic, stim., aphrodis., in spermatorrhœa.

Albumen—emol., demulc., nutri., antid. for copper, zinc, perchloride of mercury and creosote poisoning.

Alectoris græa Meisner—Bartavelli (S.-Upachakra, B.-Chakor); flesh—astrin., generative of strength, stomch.

Ambergris—Ambergris. (S.-Amber-sugandah, H., B., Bo. & M.-Amber); stim., antisp., given in high fever; ambrein.

Anabas scandens Daldorf. (S.-Kabayee, H.-Kabai, B.-Kai); flesh—astrin., demulc., easily digestible, cardiac stim., slight bilious and alleviative of wind.

Animal flesh:—

(*a*) **Jangla** or **land animals**; astrin., digest., constipating

(*b*) **Anupa** or **water animals**; demulc., fattening, soothing.

Antigone antigone Linn.—Indian Crane (S.-Sarasa, B.-Saras); flesh—difficult to digest, antibil, beneficial in diar. and piles.

Anser indicus Lath.—Gander or Drake (S.-Hansa, B.-Hans, Bo.-Ballaki); flesh—stim., difficult to digest, demulc., nutri., phlegm., corrective of voice and alleviative of 'vayu'; egg—stim., easily digestible, cardiac stim., aphrodis., beneficial in cough, heart disease, ulcers.

Antilope cervicapra Linn.—Indian Antelope or Black Buck. (S.-Ena-mriga, H.-Farisail Harin); flesh—astrin., stomch., useful in fever, ulcer, phthisis, piles, jaundice, cough.

Apis mellifera—The Honey Bee; honey—nutri., demulc., laxt.; especially for children, useful in application to ulcer.

Aquus asinus Linn.—Ass (S.-Gardhava, H.-Gadha); milk—stomch., cardiac stim., useful in wind and phthisis; ghee—astrin., stim., antiphlegm., easily digestible; flesh—cardiac stim.; urine—stim., stomch., useful in gout.

Aredeola grayii Sykee.—Heron (S.-Krauncha, B.-Konch Bak); flesh—used in fever, phthisis, cough, œdema, loss of appetite, swoon and stone in the bladder.

Arius arius Ham. & Buch.—Fish (S.-Ari-matsya, B.-Armach); flesh—difficult to digest, demulc., cardiac stim., improves memory, wind and phlegm.

Athene brama indica—Owl (S.-Ulooka, B.-Pechak); flesh—stim., produces 'vayu', cholag.; useful in œdema, insanity and loss of semen.

Barbus sophore Ham. & Buch.—Fish (S.-Proshti, B.-Punti-máchh); sweetish bitter, demulc., antiphlegm., alleviative of 'vayu' and beneficial in the diseases of mouth and throat.

Bezoar—Serpent stone. (H., B. & Bo.-Gorochan, M.-Gorochana); cooling, arom., prescribed in miscarriage.

Bivalve shell (S.-Sukali, Bo.-Chhipa, P.-Sip); chhipa bhasma—used in depilatory pastes.

Bombys mori—Moth. The chrysalis is the silk pod. (B.-Pat, Bo.-Resham na potan, M.-Putloo puchic); styptic, tonic, astrin., checks profuse menstruation, leucor. and chr. diar.

Bos bubalus Linn.—Buffalo (S.-Mahisha, H.-Bhais, B.-Mahish, M.-Dunnaputu); flesh—stim., demulc., difficult to digest, cardiac stim., milk—refrig., difficult to digest, demulc., cardiac stim., aphrodis., phlegm., hypnotic.

Bos taurus Linn.—Cow (S.-Go, Gabhi, B.-Goru); **milk**—demulc., nutri., cardiac tonic, excitive of memory; **ghee**—stomch., nutri., antibil., tonic, improves memory; **flesh**—useful in fever, disease of the nose, cough, phthisis and catarrh; **cow-dung**—used in burns and wounds; **urine**—see URINE.

Callichrous pabda Ham. & Buch.—Fish (S.-Parbata, B.-Pabda); flesh—demulc., cardiac stim. and carmin.

Camelus dromodarius Linn.—Camel (S.-Ustra, H.-Ur, B.-Ut); milk—easily digestible, stim., stomch., useful in piles, œdema, worms, abdominal tumours, dropsy, phthisis and leprosy; ghrita—refrig., stomch., useful in convulsion, worms, leprosy; urine—stim., bilious, cardiac stim., useful in dropsy.

Carcharodon carcharius Linn.—White shark; oil—subst. for cod-liver oil, richer in iodine and phosphorus than cod-liver oil but contains less bromine and sulphur.

Castoreum—Dried preputial follicles of the beaver—Castor. (S.-Gendha, H.-Gondbadustan, Bo.-Zanda bidastara, M.-Kasturi munai); nerve stim., antisep., emmen.; contains a volatile oil, acrid bitter resin, castorin, cholesterin and salicin

Catla-catla Ham. & Buch.—Fish (S.-Katala, B.-Katla); flesh—stim., difficult to digest and beneficial in disturbance of the three humours.

Capra-aegagrus Gmelin—Goat; flesh—nourishing, cardiac stim., milk—sweet, cooling, astrin., beneficial in fever, bile, cough, consumption and dysen; 'chagaladya-ghrita'—specific for nervous debility.

Cephalopoda. see OS SEPIE.

Cera (S.-Siktha, H.-Mom, Bo.-Mum, M.-Mellugu); emol., demulc., contain hydrocarbons, cerotic acid, myricin, ceryl alcohol.

Cera alba—White bee's wax; local application for fistula.

Cerevesia lactis; see KUMYSS.

Cervus dama Linn.—Hart's Horn (S.-Mrigasringa); in cough, asthma, low fever, phosphaturia; contains phosphate of lime.

Cervus elephus or **C. equinus**—Stag's Horn (S.-Samberasinga, H.-Barasinga); local astrin., sedative, internally nerve and blood tonic; contains calcium phosphate.

Cetaceum—Spermaceti; demulc., emol.; contains cetyl alcohol combined with palmitic acid.

Chelonia—Turtle (H.-Kachakru); fat—used in scrofula, rickets, anæmia and pulmonary affections.

Clamator jacobinus Bodd.; **Aegithina tiphia** Linn.—Swallow (S.-Chataka H.-Tokka, B.-Chatak); flesh—refrig., stomch., cardiac stim., nutri., in epistaxis and phlegm.

Clarias batrachus Linn.—Fish (S.-Madgura, B.-Magur); flesh—demulc., used *in diar.*

Clupea ilisha Ham. & Buch. (S.-Illisa, H.-Hilsa, B.-Ilis); flesh—demulc., stomch., bilious, phlegm., carmin.

Coccus cacti—Cochineal insect (H.-Beerbough tee, Bo.-Kiramaja, M.-Cochinil puchi); sedative, antisp., in neuralgia and whooping cough; contains carmine or carminic acid, coccerin, myrestin, fat and fatty acids.

Columba domestica—Pigeon; (S.-Kapota, H.-Kobutar, B.-Payra); flesh—demulc., tonic, cardiac nutri., in constip., beneficial in phlegm., bile, vitiated blood and wind, leprosy, prohibited in jaundice

Corallium rubrum—Coral (S.-Pravala, H.-Parvara, Bo. & M.-Povale); antacid, astrin., laxt., diur., nerve tonic; contains carbonate of lime, magnesium carbonate, oxide of iron.

Corvus-splendens-splendens Vieill.—Crow (S.-Káka, B.-Kák); flesh—stomch., nutri., cardiac stim., beneficial in ulcer, phthisis and eye disease.

Crocodilus porosus Schneid—Crocodile (S.-Kumbhira, B.-Kumir); flesh—demulc., refrig., beneficial in vitiated bile.

Crocopus phœnicopterus Lath.—The green dove (S.-Harita, H.-Harial, B.-Hathela Ghugu); flesh—astrin., refrig., easily digestible, produces 'vayu' and alleviates thirst and epistaxis.

Cypræa moneta Linn.—Shells, Cowry (S.-Varatika, H.-Cowrie, Bo. & M.-Kavdi); cowri bhasma—used in dyspep., jaundice, enlarged spleen and liver; contains phosphate, fluoride and carbonate of calcium, magnesium phosphate, manganese.

Elephas maximus—Elephant (S.-Hasti, B.-Hati, Bo. & M.-Aane); teeth ash—astrin., in leucor., used in jaundice, conjunctivitis and sterility in women.

Equus caballus Linn.—Horse (S.-Asva); milk—stim., demulc.; urine—bitter, stim., stmch., purg., beneficial in ringworm and intestinal worm.

Eudynamis scolopaceus Linn.—Cuckoo (S.-Kokila, H.-Koil, B.-Kokil); flesh—phlegm., antibil.

Fel bovinum purificatum or **Fel tauri depuratus**—Purified Ox-Gall (S.-Gorochanam, H.-Zehar-mohra, Bo. & M.-Gorochana); laxt., antisp., cholag., cooling, arom., used in convulsions, hysteria.

Fel bovis—Fresh Ox-Gall (H.-Bail-ka-sofra).

Felis tigris Linn.; Tiger fat is used in leprosy, in rheum.

Francolinus pondicerianus Gmel.—Partridge (S.-Tittiri, B.-Titir, M.-Toluk petta); the flesh of the white variety is astrin., refrig., demulc., easily digestible, constipating, cardiac stim., improves memory, beneficial in cough, phthisis, fever, epistaxis and hiccough.

Gallus bankiva Zemm.—denotes wild form of the genus. The Indian domesticated game-cock is known as **Gallus pugnex**=**Gallus pusillus** of Linnæus; egg—(S. & B.-Dimba, H.-Anda, Bo.-Bedun, M.-Motte); emol., demulc., laxt., nutri., contains albumen, mucus, fat, sugar, extractive matter, lecithin.

Gallus domesticus—Fowl; flesh—stim., demulc., cardiac stim., nutri., beneficial in disturbance of the three humours, phthisis, vomiting and remittent fever.

Halicore dugong Erxleben; Dugong oil or oil of Sea Hog subst. for cod-liver oil.
Hirudinaria (Pœcilobdella) granulosa Savigny—Leech (S.-Jaluka, H., B. & Bo.-Jalu, M.-Attei); antiphl. anticoagulant.

Iris nobilis; see CORALLIUM RUBRUM.

King-fisher; (B.-Macch ranga); flesh—refrig., demulc., useful in epistaxis, produces 'vayu'.
Kumyss or **Kumiss**; fermented mare's or camel's milk—dietetic, restor., given in diabetes, irritability of stomach and vomiting; contains alcohol, sugar, lactic acid, salts, carbonic acid, ether.

Lacca; see COCCUS LACCA.
Lactus—Milk (S.-Dugdha).
Black cow's milk—good for 'vayu.'
Goat's milk—useful in phthisis, chr. diar., vomiting in children.
Ewe's milk—useful in rheum., hacking cough.
Sheep's milk—useful in obesity, flatulence and gonor.
Ass's milk—useful in general debility, cough, chr. broncht.
Mare's milk—useful in rheum. of extremities.
Camel's milk—useful in dropsy, asthma, general scrofulous conditions.
Human milk—refrig., stomch., demulc., beneficial in eye diseases and epistaxis, recommended in chr. asthma and consumption.
Elephant's milk—beneficial to eyes.
Lepus ruficaudatus Geoff.—Rabbit (S.-Sasaka, B.-Khargosh); flesh—refrig., astrin., stomch., cardiac stim., beneficial in fever, jaundice, diar. with fever, phthisis, cough and piles.
Lobeo rohita Ham. & Buch.—Fish (S.-Rohita, H.-Rahu, B.-Rui-machh, M.-Erammu)); flesh—astrin., slight stim., difficult to digest, demulc., cardiac stim., strengthening, slight bilious, beneficial in vitiated wind; bile—laxt., in bilious remittent fever.

Macacus rhesus—Monkey (S., H. & B.-Banar); flesh—difficult to digest, hæmatinic, beneficial in eye diseases, phthisis, cough and piles.
Mel—Honey (S.-Madhu, H. & Bo.-Madha, M.-Tæn); demulc., laxt., nutri.; contains various sugars.
Mel depuratum—Clarified Honey; demulc., laxt., nutri.; contains various sugars.
Moschus moschiferous Linn.—Musk-Deer; (S., B., Bo. & M.-Gorochanam, H.-Zehar-mohra; laxt., antisp., Kasturi); diffusible stim., anodyne, antisp., expect., diaphor., diur., aphrodis.; contains cholesterin, fat, wax, gelatinous matter, albuminous principles.
Motacilla maderaspatensis Gmelin—common Wagtail; (S.-Khanjana, B.-Bond-na-cha); flesh—laxt. and beneficial in diseases originated from vitiated phlegm and bile.

Mugil planiceps Cuv & Val.—Fish (S.-Bhokani, B.-Bhangan); flesh—refrig., phlegm, difficult to digest.
Mus rattus—Mouse (S.-Mushika, H.-Chua, Mush, B.-Indur); flesh—demulc., cardiac stim., useful in worms and piles.
Mutella occidentalis (S.-Indravadhi, H.-Indragopa); nerve tonic, antisp., used in paralysis.
Mylabris chicorii—Mylabris beetle (H.-Telenimakhi, M.-Puis-tarinai); subst. for cantharides; cantharidin. (see page 193).
M. pustulata—Cantharides (H.-Teleni makhi); internally stim., diur., externally a powerful and valuable counter-irrit., vesicant. (see page 193).

Os sepie—Cuttle fish bone (S.-Samudraphena, H.-Darya-kaf); antacid, astrin., local sedative; contains calcium carbonate, phosphate, sulphate with silica.
Ostrea edulis Linn.—Oyster—The common Indian species is **O. gryphoides** Schl. (H.-Sipi, B.-Jalasukti, Jhinuk, Bo.-Kalu); flesh—acrid, demulc., useful in phthisis, 'sula' and heart diseases; ash—useful in dyspep.; contains calcium carbonate, phosphate, sulphate, magnesium, iron oxide, alumina and silica.
Ovis aries—Sheep (S.-Mesha, H. & Bo.-Bhakri, M.-Aedu); flesh—refrig., difficult to digest, excitive of bile.
Ovis vignei Bath.—Sheep (S.-Abika, Mesha, B.-Bhera, Mesh); flesh—difficult to digest, excitive of bile and phlegm; urine—stim., beneficial in leprosy, piles, 'sula', dropsy, œdema and gonor.

Palæmon curcinus Prawn. (S.-Chingati, B.-Chingri); flesh—difficult to digest, constipating, cardiac stim., phlegm., beneficial in obesity, bile and vitiated blood.
Passer domesticus Linn.—Sparrow (S.-Chataka, H.-Chaburanja, B.-Charai pakhi); flesh—palatable, refrig., demulc., cardiac stim. and aphrodis.
Pavo cristatus Linn.—Peacock (S.-Nilkantha, H.-Mur, B.-Maur, Bo.-Mor, M.-Mail); flesh—used for contracted limbs; grease—used medicinally.
Pearl—see MYTILUS MARGARITIFERUS.
Perdix sylvatica—Bird (S.-Krakara, H.-Kayar, B.-Karkati, Bo.-Kardhanka); flesh—cardiac stim., improves memory and digestion, useful in wind, bile and beneficial in epistaxis.
Phalacrocorax niger—Diver (S.-Valakaka, B.-Pankauri); flesh—demulc., difficult to digest, refrig., alleviative of 'vayu'.
Phasianus; see GALLUS.
Physeter macrocephalus; see CATACEUM.
Pinctada margaritifera Linn.—Pearl (S.-Mukta, H. & Bo.-Moti, M.-Muttu); ash—stim., tonic, aphrodis., laxt., sedative, emetic, nutri., antacid.
Pisces—Fish (S.-Matsya, H.-Machchi); **river fish**—difficult to digest, checks 'vayu', deranges 'pitta' and blood, and causes bulky stool, **shallow water fish**—deranges 'pitta,' **tank and pond fish**—palatable and checks 'vayu' and 'pitta,' **lake fish**—difficult to digest, **fish near spring water**—similar in properties to lake fish, **well-water fish**—deranges 'kapha'.
Psittacula krameri Scop.—Parrot (S.-Suka, B.-Tia); flesh—easily digestible, refrig., stomch., cardiac stim., constipating, beneficial in cough and phthisis.

Rana-tigrina (frog), **Bufo melanosticus** (toad); (S.-Bheka, B.-Byang); flesh—cardiac stim., phlegm., slight bilious, alleviates thirst, gonor., phthisis, leprosy, vomiting.

Rennet (H.-Paneermaya, Pes).

Reptiles.

Lizard; flesh—tonic, stim., alter., used in syphilis; oil—aphrodis.

Serpent poison; stim., used in collapse stage of fever and cholera.

Gecko verticillatus Laur. (S.-Musali, B.-Takshakha, H.-Chipkuli, M.-Paillie); used in leprosy.

Mabuia carinata Schneid.—Indian Skink (P.-Regmahi); oil—restor., stim., aphrodis., astisyp.

Varanus bengalensis Daud—Iguana (H.-Gosamp); used in consumption.

V. salvator; cures cutaneous disorders.

Python reticulatus Schneid.; gall bladder—used medicinally.

Rhinoceros unicornis Linn.—The great one-horned Rhino (S.-Khargee, B.-Gandar); flesh—astrin., difficult to digest, nutri., cardiac stim. and alleviative of vomiting and epistaxis.

Saccobranchus fossilis Bloch.—Fish (S.-Sringi, B.-Singi); flesh—demulc., easily digestible, cardiac stim., aphrodis., galact., in dropsy, jaundice, bile, phlegm and wind.

Saccharum lactis; see LACTUS.

Scilla serrata—Crab (S.-Karkataka, B.-Kankra); antibil., diur., laxt., hæmatinic, cardiac stim. and alleviative of 'vayu'.

Scomberomorus commersonii Lacép.—Seir fish (H.-Surmoyi, M.-Konam); subst. for cod or shark oil.

Sepia officinalis, see OS SEPIE.

Serpent poison (S.-Sarpavisha); see SNAKE VENOM, p. 439.

Snake (S.-Sarpa, B.-Sáp); flesh—stomch., beneficial in eye-disease, piles, worms.

Spongilla—The Sponge (H.-Badala, Bo.-Vadulun); astrin.; contains gelatine, albumen and iodine.

Taccardia lacca—Lac (S.-Laksha, B.-Gala, Bo. & M.-Lakh); given in hæmatemesis, caries.

Trichogaster fasciatus Bl. Schn.—Fish (S.-Khalis, B.-Khalse); flesh—astrin., constipating, produces wind and alleviative of 'sula'.

Turbinella rapa.—Conch (S. & Bo.-Shankha, M.-Sanka); anodyne, carmin., digestive, astrin.

Turnix m. tanki Blyth. and **Turnix dussumieri** Zemm.—Bird (S.-Laba, H.-Lawa, B.-Baterpakhi, M.-Labuwapetta); flesh—astrin., demulc., constipating, stomch. and beneficial in disturbance of the three humours.

Univalve; see GASTROPODA.

Urine (S.-Mutra, H.-Pesab); **cow's urine**—laxt., diur., used in cirrhosis of the liver; **goat's urine**—for fever, headache; **ox's urine**—stomch., used in jaundice, worms, œdema and diar.; **horse's urine**—bitter, stim., stomch., purg., used in ringworm and intestinal worms; **human urine**—stim., stomch., cardiac stim., useful in wind, worms, skin disease.

Viverra zibetta Linn.—Civet cat (S.-Gandha marjara, H. & Bo.-Ladana); unctuous secretion—stim., aphrodis., antisp.

Whale (S. & B.-Timi); flesh—stim., demulc., difficult to digest, constipating, induces dyspep., cardiac stim., phlegm and carmin.

Xanchus pyrum—Conch shell (S.-Sankha, B.-Sankh); flesh—demulc., cardiac stim., nutri., phlegm., useful in phthisis, abdominal tumours.

SECTION IV

MISCELLANEOUS

PLANT REMEDIES USED IN SNAKE-BITE

A large number of medicinal plants have been used in the treatment of snake-bites in Indian indigenous medicine. With a view to find out whether the exaggerated claims put forward on their behalf have any basis of truth, Caius and Mhaskar of the Haffkine Institute, Bombay, (Indian Medical Research Memoirs No. 19, January, 1931) have carried out extensive pharmacological and toxicological investigations on animals. Healthy dogs weighing from 6 to 10 kilos were injected subcutaneously with both Cobra and Daboia venoms and the antidotal effects of the various remedies on such animals were noted. The remedies were administered in strict conformity with the directions laid down in the standard books of Indian medicine. The samples used in these experiments were all obtained fresh from the garden or the bazar. For internal administration, a concentrated watery extract of the powdered plant was used. For external application, the concentrated watery solution was instilled by means of a pipette into the eyes or nostrils of experimental animals. Sometimes the finely ground powder was rubbed directly over the site of inoculation of the venom. The dosage indicated in the literature was adhered to by these workers as far as possible. A list of the plant remedies experimented upon is given below. The opinion of these workers is that none of the following Indian plants recommended for the treatment of snake-bite has any preventive, antidotal or therapeutic effect :—

Abrus precatorius *Linn.*, Acacia arabica *Willd.*, Acacia catechu *Willd.*, Acacia concinna *DC.*, Acacia farnesiana *Willd.*, Acacia pennata *Willd.*, Acalypha indica *Linn.*, Acanthus ilicifolius *Linn.*, Achyranthes aspera *Linn.*, Aconitum ferox *Wall.*, Aconitum heterophyllum *Wall.*, Acorus Calamus *Linn.*, Actæa spicata *Linn.*, Adhatoda Vasica *Ness.*, Ægle marmelos *Correa.*, Ailanthus malabarica *D.C.*, Alangium lamarkii *Thw.*, Albizzia lebbek *Benth.*, Allium sativum *Linn.*, Alstonia scholaris

R. Br., Alternanthera sessilis *Br.*, Althæa officinalis *Linn.*, Althæa rosea *Linn.*, Amarantus spinosus *Linn.*, Amarantus tristis *Linn.*, Amarantus viridis *Linn.*, Amomum subulatum *Roxb.*, Anacardium occidentale *Linn.*, Anagallis arvensis *Linn.*, Anamirta cocculus *W. & A.*, Andropogon muricatus *Retz.*, Andropogon schœnanthus *Linn.*, Aneilema scapiflorum *Wight.*, Anisomeles malabarica *R. Br.*, Anogeissus latifolia *Wall.*, Anthocephalus cadamba *Mig.*, Antidesma bunias *Muell.Arg.*, Aquilaria agallocha *Roxb.*, Areca catechu *Linn.*, Argemone mixicana *Linn.*, Arisæma speciosum *Mart.*, Aristolochina bracteata *Retz.*, Aristolochina indica *Linn.*, Aristolochina longa *Linn.*, Aristolochia serpentaria *Linn.*, Artemisia maritima *Linn.*, Artemisia vulgaris *Linn.*, Arthrocnemum indicum *Moq.*, Artocarpus integrifolia *Linn.*, Asparagus racemosus *Wild.*, Atalantia monophylla *Correa*, Balanites Roxburghii *Planch.*, Baliospermum axillare *Blume.*, Balsamodendron roxburghii *Arn.*, Bambusa arundinacea *Retz.*, Barleria cristata *Linn.*, Barringtonia acutangula *Gærtn.*, Bassia longifolia *Willd.*, Bauhinia tomentosa *Linn.*, Bauhinia variegata *Linn.*, Benincasa cerifera *Savi.*, Berberis asiatica *Roxb.*, Betula bhojpattra *Wall.*, Bixa orellana *Linn.*, Bœrhaavia diffusa *Linn.*, Bombax malabricum *DC.*, Boswellia serrata *Roxb.*, Bragantia wallichii *R. Br.*, Brassica campestris *Linn.*, Brassica nigra *Koch.*, Butea frondosa *Roxb.*, Butea superba *Roxb.*, Cæsalpinia bonducella *Fleming.*, Cajanus indicus *Spreng.*, Calamus rotang *Linn.*, Calotropis gigantea *R. Br.*, Calycopteria floribunda *Lamk.*, Capsicum annuum *Linn.*, Cardiospermum halicacabum *Linn.*, Careya arborea *Roxb.*, Carum copticum *B. & H.*, Caryophyllus aromaticus *Linn.*, Cassia alata *Linn.*, Cassia fistula *Linn.*, Cassia occidentalis *Linn.*, Cassia sophera *Linn.*, Cassia tora *Linn.*, Cedrus deodara *Loudon.*, Celastrus senegalensis *Lamk.*, Cephalandra indica *Naud.*, Cicer arietinum *Linn.*, Cinnamomum tamala *Nees.*, Cinnamomum zeylanicum *Breyn.*, Cissampelos pareira *Linn.*, Citrullus colocynthis *Schrad.*, Citrus medica *Linn.*, Clematis triloba *Heyne.*, Cleome viscosa *Linn.*, Clerodendron infortunatum *Gærtn.*, Clerodendron serratum *Spreng.*, Clitoria ternatea *Linn.*, Cocos nucifera *Linn.*, Coix lachryma *Linn.*, Commelina obliqua *Ham.*, Corallocarpus epigæa *Hook.f.*, Cordia obliqua *Willd.*, Coriandrum sativum *Linn.*, Coscinium fenestratum *Colebr.*, Costus speciosus *Smith.*, Cratæva religiosa *Forst.*, Crocus sativus *Linn.*, Croton oblongifolius *Roxb.*, Croton tiglium *Linn.*, Cucumis trigonus *Roxb.*, Cuminum cyminum *Linn.*, Curcuma aromatica *Salisb.*, Curcuma longa *Linn.*, Cyclamen persicum *Miller.*, Cynodon dactylon *Pers.*, Cyperus rotundus *Linn.*, Dæmia extensa *R.Br.*, Datura fastuosa *Linn.*, Dendrobium macræi *Lindl.*, Derris scandens *Benth.*, Desmodium gangeticum *DC.*, Dioscorea oppositifolia *Linn.*, Diospyros embryopteris

Pers., Doronicum pardalianches *Linn.*, Elæodendron glaucum *Pers.*, Elephantopus scaber *Linn.*, Elettaria cardamomum *Maton.*, Embelia ribes *Burm.*, Ervum lens *Linn.*, Erythrina indica *Lam.*, Eupatorium ayapana *Vent.*, Euphorbia antiquorum *Linn.*, Euphorbia neriifolia *Linn.*, Euphorbia thymifolia *Burm.*, Fagonia arabica *Linn.*, Feronia elephantum *Correa.*, Ferula fœtida *Regel.*, Ficus bengalensis *Linn.*, Ficus carica *Linn.*, Ficus glometara *Roxb.*, Ficus religiosa *Linn.*, Ficus rumphii *Blume.*, Flacourtia sepiaria *Roxb.*, Flueggia microcarpa *Blume.*, Fœniculum vulgare *Gærtn.*, Gloriosa superba *Linn.*, Glossogyne pinnatifida *DC.*, Glycosmis pentaphylla *Correa.*, Glycyrrhiza glabra *Boiss.*, Gmelina arborea *Linn.*, Gossypium herbaceum *Linn.*, Gymnema sylvestre *Br.*, Gynandropsis pentaphylla *DC.*, Hedychium spicatum *Ham.*, Helianthus annuus *Linn.*, Helicteres isora *Linn.*, Heliotropium eichwaldi *Steud.*, Heliotropium indicum *Linn.*, Heliotropium strigosum *Willd.*, Heliotropium undulatum *Vahl.*, Hemidesmus indicus *R.Br.*, Herpestis monniera *H. B. & K.*, Heterophragma roxburghii *DC.*, Hibiscus abelmoschus *Linn.*, Holarrhena antidysenterica *Wall.*, Hugonia mystax *Linn.*, Hydrocotyle asiatica *Linn.*, Ichnocarpus frutescens *Br.*, Indigofera tinctoria *Linn.*, Ionidium suffruticosum *Ging.*, *Ipomæa* biloba *Forsk.*, Ipomæa bona-nox *Linn.*, Ipomæa campanulata *Linn.*, Ipomæa digitata *Linn.*, Ipomæa turpethum *Br.*, Jasminum grandiflorum *Linn.*, Jasminum pubescens *Willd.*, Killinga monocephala *Linn.*, Lantana indica *Roxb.*, Leucas aspera *Spreng.*, Leucas linifolia *Spreng.*, Leucas zeylanica *Br.*, Limonia acidissima *Linn.*, Liquidambar orientalis *Miller.*, Litsæa sebifera *Pers.*, Lobelia nicotianæfolia *Heyne.*, Luffa acutangula *Roxb.*, Luffa echinata *Roxb.*, Luvunga scandens *Ham.*, Mallotus philippinensis *Muell.Arg.*, Mangifera indica *Linn.*, Matthiola incana *R.Br.*, Melia azadirachta *Linn.*, Mesua ferrea *Linn.*, Michelia champaca *Linn.*, Mimosa pudica *Linn.*, Mimusops elengi *Linn.*, Momordica charantia *Linn.*, Momordica dioica *Roxb.*, Moringa pterygosperma *Gærtn.*, Mucuna pruriens *DC.*, Murraya kœnigii Spreng. Musa sapientum *Linn.*, Myrica nagi *Thunb.*, Myristica fragrans *Houtt.*, Nardostachys jatamansi *DC.*, Nelumbium speciosum *Willd.*, Nerium odorum *Soland.*, Nigella sativa *Linn.*, Nyctanthes arbor-tristis *Linn.*, Ocimum basilicum *Linn.*, Ocimum gratissimum *Linn.*, Ocimum sanctum *Linn.*, Oldenlandia umbellata *Linn.*, Ophiorrhiza mungos *Linn.*, Opuntia dillenii *Haw.*, Oroxylum indicum *Vent.*, Papaver somniferum *Linn.*, Paramignya monophylla *Wight.*, Parmelia perlata *Esch.*, Pentapetes phœnicea *Linn.*, Pericampylus incanus *Miers.*, Peristrophe bicalyculata *Nees.*, Phaseolus mungo *Linn.*, Phaseolus trilobus *Ait.*, Phyllanthus distichus *Muell.Arg.*, Phyllanthus emblica *Linn.*, Phyllanthus niruri *Linn.*, Physalis minima *Linn.*, Picrorrhiza kurrooa *Benth.*,

Pinus longifolia *Roxb.*, Piper betle *Linn.*, Piper longum *Linn.*, Piper nigrum *Linn.*, Piper sylvaticum *Roxb.*, Pistacia integerrima *Stewart.*, Pittosporum floribundum *W. & A.*, Plantago amplexicaulis *Cav.*, Plumbago rosea *Linn.*, Plumeria acutifolia *Poir.*, Pogostemon parviflorus *Benth.*, Polycarpaea corymbosa *Lamk.*, Polygala crotalarioides *Ham.*, Pongamia glabra *Vent.*, Pothos scandens *Linn.*, Premna harbacea *Roxb.*, Prosopis spicigera *Linn.*, Prunus Mahaleb *Linn.*, Prunus Puddum *Roxb.*, Psoralea corylifolia *Linn.*, Pterocarpus santalinus *Linn.*, Punica granatum *Linn.*, Putranjiva roxburghii *Wall.*, Randia dumetorum *Lamk.*, Rauwolfia serpentina *Benth.*, Rhinacanthus communis *Nees.*, Ricinus communis *Linn.*, Rubia cordifolia *Linn.*, Rumex vesicarius *Linn.*, Rungia repens *Nees.*, Saccharum officinarum *Linn.*, Salvadora oleoides *Dcne.*, Salvadora persica *Linn.*, Sansevieria zeylanica *Willd.*, Santalum album *Linn.*, Sapindus trifoliatus *Linn.*, Saraca indica *Linn.*, Saussurea lappa *Clarke.*, Schleichera trijuga *Willd.*, Scindapsus pertusus *Schott.*, Semecarpus anacardium *Linn.*, Sesamum indicum *DC.*, Sesbania grandiflora *Pers.*, Shorea robusta *Gærtn.*, Sida carpinifolia *Linn.*, Sida rhombifolia *Linn.*, Solanum indicum *Linn.*, Solanum nigrum *Linn.*, Solanum xanthocarpum *S. & W.*, Spondias mangifera *Willd.*, Stereospermum chelonoides *DC.*, Streblus asper *Lour.*, Strychnos colubrina *Linn.*, Strychnos nux vomica *Linn.*, Strychnos potatorum *Linn.*, Symplocos racemosa *Roxb.*, Tabernæmontana dichotoma *Roxb.*, Taxus baccata *Linn.*, Tectona grandis *Linn.*, Terminalia arjuna *W. & A.* Terminalia belerica *Roxb.*, Terminalia chebula *Retz.*, Terminalia tomentosa *W. & A.*, Tiliacora racemosa *Coleb.*, Tinospora cordifolia *Miers.*, Trachylobium hornemannianum *Heyne.*, Trapa bispinosa *Roxb.*, Trichodesma indicum *Br.*, Trichosanthes dioica *Roxb.*, Typhonium trilobatum *Schott.*, Uraria lagopoides *D.C.*, Uraria picta *Desv.*, Valeriana wallichii *DC.*, Vanda roxburghii *R.Br.*, Vangueria spinosa *Roxb.*, Vateria indica *Linn.*, Verbena officianalis *Linn.*, Vernonia anthelmintica *Willd.*, Vitex agnus-castus *Linn.*, Vitex negundo *Linn.*, Vitis vinifera *Linn.*, Withania somnifera *Dunal.*, Woodfordia floribunda *Salisb.*, Wrightia tomentosa *Röm. & Schult.*, Xanthium strumarium *Linn.*, Zanthoxylum alatum *Roxb.*, Zingiber cassumunar *Roxb.*, Zingiber officinale *Roscoe.*

PLANT REMEDIES USED IN SCORPION-STING

Caius and Mhaskar of the Haffkine Institute, Bombay, (Indian Medical Research Memoirs No. 24, June, 1932), have recently carried out a detailed investigation into the action of the venom of Indian scorpions by modern physiological

methods. The treatment of scorpion-stings by medicinal plants, indigenous or imported, used in India has also been referred to. As the subject is likely to be of interest to the readers of this book, a summary of the important findings and the main conclusions is given below.

The scorpions more commonly met with in India belong to either genus *Buthus* or genus *Palamnœus*, the *Buthus* variety being more poisonous. Contrary to popular belief, scorpion-sting has been found to be very rarely fatal to human beings. Different animals, however, exhibit different degrees of resistance to the action of the venom. Scorpion venom resembles snake venom in many of its characteristics. The following active principles have been isolated from it :—(1) Neurotoxins which act principally on the vasomotor and respiratory centres and on the nerve-endings in striated and unstriated muscles, (2) hæmolysins, agglutinins, hæmorrhagins, leucocytolysins, coagulants, ferments, lecithin and cholesterin, (3) a cardiac tonic principle and (4) a vascular tonic principle.

Pharmacological Action :—Scorpion venom when injected into the skin causes intense local irritation due to stimulation of the terminations of the sensory nerves of the skin. When it is injected into the blood stream, the vasomotor and respiratory centres are stimulated leading to a rise of blood pressure and an increase of the respiratory excursions. Excessive lachrymal, nasal and salivary secretions are also noticed owing to stimulation of the facial nerve centres. Spasmodic contraction of the musculature of the intestine and urinary bladder is evident. On the smooth muscle, the venom appears to act like the pilocarpine group of drugs by stimulating the nerve endings of the parasympathetic system. The heart is definitely stimulated and continues to beat even after the paralysis of the respiratory centre. The nervous system is generally excited. Reflexes are increased as evidenced by shivering, tremor and muscular twitchings. Sometimes strychnine-like convulsions are noticed. Later paresis or paralysis of muscles occur, due to the affection of the motor nerve endings. Death in experimental animals is always due to direct paralytic action of the venom on the respiratory centre.

Treatment of Scorpion-stings :—The antivenom prepared at Kasauli against cobra and daboia venoms imparts a certain amount of protection to rabbits and dogs receiving lethal doses of the scorpion venom. A large number of indigenous remedies from the vegetable kingdom has been tried. None of the Indian remedies popularly used has been found to have any preventive, antidotal or therapeutic effect. The list of such drugs is given below.

Achyranthes aspera *Linn.*, Aconitum ferox *Wall.*, Aconitum heterophyllum *Wall.*, Acorus calamus *Linn.*, Adiantum venustum *Don.*, Albizzia lebbek *Benth.*, Allium cepa *Linn.*, Alocasia macrorhiza *Schott.*, Alstonia scholaris *R.Br.*, Amarantus viridis *Linn.*, Amomum subulatum *Roxb.*, Andropogon muricatus *Retz.*, Andropogon schœnanthus *Linn.*, Anisomeles malabarica *R.Br.*, Anogeissus latifolia *Wall.*, Aquilaria agallocha *Roxb.*, Areca catechu *Linn.*, Aristolochia indica *Linn.*, Artemisia maritima *Linn.*, Artemisia vulgaris *Linn.*, Arthrocnemum indicum *Moq.*, Artocarpus integrifolia *Linn.*, Asparagus racemosus *Willd.*, Baliospermum axillare *Blume*, Balsamodendron roxburghii *Arn.*, Bambusa arundinacea *Retz.*, Barleria cristata *Linn.*, Bassia longifolia *Willd.*, Bauhinia tomentosa *Linn.*, Berberis asiatica *Roxb.*, Bœrhaavia diffusa *Linn.*, Bombax malabaricum *DC.*, Borassus flabelliformis *Linn.*, Boswellia serrata *Roxb.*, Barassica nigra *Koch.*, Butea frondosa *Roxb.*, Butea superba *Roxb.*, Calamus rotang *Linn.*, Calotropis gigantea *R.Br.*, Cardiospermum halicacabum *Linn.*, Careya arborea *Roxb.*, Carthamus tinctorius *Linn.*, Carum copticum *B. & H.*, Cassia alata *Linn.*, Cassia Fistula *Linn.*, Cassia sophera *Linn.*, Cassia tora *Linn.*, Cedrus deodara *Loudon.*, Cephalandra indica *Naud*, Ceratophyllum demersum *Linn.*, Cinnamomum tamala *Nees.*, Cinnamomum zeylanicum *Breyn.*, Cissampelos pareira *Linn.*, Citrullus colocynthis *Schrad.*, Citrus medica *Linn.*, Clerodendron infortunatum *Gærtn.*, Clerodendron serratum *Spreng.*, Clitoria ternatea *Linn.*, Colocasia antiquorum *Schott.*, Cordia obliqua *Willd.*, Coriandrum sativum *Linn.*, Cratæva religiosa *Forst.*, Crocus sativus *Linn.*, Croton tiglium *Linn.*, Cucurbita maxima *Dcne.*, Cuminum cyminum *Linn.*, Curcuma longa *Linn.*, Curcuma zedoaria *Roscoe*, Cynodon dactylon *Pers.*, Cyperus rotundus *Linn.*, Datura fastuosa *Linn.*, Dendrobium macraei *Lindl.*, Desmodium gangeticum *DC.*, Dioscorea oppositifolia *Linn.*, Eclipta alba *Hassk.*, Elettaria cardamomum *Maton.*, Embelia ribes *Burm.*, Eriodendron anfractuosum *DC.*, Euphorbia neriifolia *Linn.*, Feronia elephantum *Correa.*, Ferula fœtida *Regel.*, Ficus glomerata *Roxb.*, Gloriosa superba *Linn.*, Glossogyne pinnatifida *DC.*, Glycyrrhiza glabra *Boiss.*, Gmelina arborea *Linn.*, Gossypium

herbaceum *Linn.*, Gynandropsis pentaphylla *DC.*, Helianthus annuus *Linn.*, Heliotropium eichwaldi *Steud.*, Heliotropium indicum *Linn.*, Hemidesmus indicus *R.Br.*, Holarrhena antidysenterica *Wall.*, Ichnocarpus frutescens *Br.*, Indigofera tinctoria *Linn.*, Ionidium suffruticosum *Ging.*, Ipomœa digitata *Linn.*, Ipomœa turpethum *Br.*, Jasminum grandiflorum *Linn.*, Justicia picta *Roxb.*, Killinga monocephala *Linn.*, Lagenaria vulgaris *Seringe.*, Leucas cephalotes *Spreng.*, Liquidambar orientalis *Miller.*, Litsæa sebifera *Pers.*, Lobelia nicotianæfolia *Heyne.*, Luvunga scandens *Ham.*, Mangifera indica *Linn.*, Martynia diandra *Glox.*, Melia Azadirachta *Linn.*, Mesua ferrea *Linn.*, Michelia champaca *Linn.*, Mimosa pudica *Linn.*, Momordica dioica *Roxb.*, Moringa pterygosperma *Gærtn.*, Mucuna pruriens *DC.*, Myrtus communis *Linn.*, Nardostachys jatamansi *DC.*, Nelumbium speciosum *Willd.*, Nicotiana tabacum *Linn.*, Nigella sativa *Linn.*, Ocimum basilicum *Linn.*, Ocimum sanctum *Linn.*, Ophiorrhiza mungos *Linn.*, Oroxylum indicum *Vent.*, Papaver somniferum *Linn.*, Parmelia perlata *Esch.*, Paspalum scrobiculatum *Linn.*, Phaseolus mungo *Linn.*, Phaseolus trilobus *Ait.*, Phyllanthus emblica *Linn.*, Physalis minima *Linn.*, Picrorhiza Kurrooa *Benth.*, Pinus longifolia *Roxb.*, Piper longum *Linn.*, Piper nigrum *Linn.*, Pistacia integerrima *Stewart.*, Plumbago rosea *Linn.*, Pogostemon parviflorus *Benth.*, Pongamia glabra *Vent.*, Prema herbacea *Roxb.*, Prosopis spicigera *Linn.*, Prunus mahaleb *Linn.*, Prunus puddum *Roxb.*, Psoralea corylifolia *Linn.*, Pterocarpus santalinus *Linn.*, Punica granatum *Linn.*, Randia dumetorum *Lamk.*, Rauwolfia serpentina *Benth.*, Ricinus communis *Linn.*, Rubia cordifolia *Linn.*, Rumex vesicarius *Linn.*, Ruta graveolens *Linn.*, Santalum album *Linn.*, Sapindus trifoliatus *Linn.*, Saraca indica *Linn.*, Saussurea lappa *Clarke.*, Scindapsus pertusus *Schott.*, Semecarpus anacardium *Linn.*, Sesamum indicum *DC.*, Shorea robusta *Gærtn.*, Sida carpinifolia *Linn.*, Sida rhombifolia *Linn.*, Solanum indicum *Linn.*, Solanum nigrum *Linn.*, Stereospermum chelonoides *DC.*, Swertia chirata *Ham.*, Symplocos racemosa *Roxb.*, Tabernæmontana dichotoma *Roxb.*, Tamarindus indica *Linn.*, Taxus baccata *Linn.*, Terminalia arjuna *W. & A.*, Terminalia belerica *Roxb.*, Terminalia chebula *Retz.*, Tinospora cordifolia *Miers.*, Trachylobium hornemannianum *Heyne.*, Tragia involucrata *Linn.*, Trapa bispinosa *Roxb.*, Trianthema pentandra *Linn.*, Tribulus terrestris *Linn.*, Trichosanthes dioica *Roxb.*, Uraria lagopoides *DC.*, Valerrana wallichii *DC.*, Vanda roxburghii *R.Br.*, Vangueria spinosa *Roxb.*, Vernonia anthelmintica *Willd.*, Vernonia cinerea *Less.*, Vitex agnus-castus *Linn.*, Vitex negundo *Linn.*, Vitis vinifera *Linn.*, Withania somnifera *Dunal.*, Wrightia tomentosa *Röm & Schult.*, Xanthium strumarium *Linn.*, Zingiber officinale *Roscoe.*, Zizyphus jujuba *Lamk.*

PLANTS CONTAINING POISONOUS PRINCIPLES

A large number of plants growing in India contains poisonous principles and may give rise to toxic symptoms in man and animals. A list of the important plants belonging to this category is given below.

PLANTS CONTAINING HYDROCYANIC ACID AND CYANOGENETIC GLUCOSIDES

Achillea millefolium *Linn.*, Aquilegia vulgaris *Linn.*, Bambusa arundinacea *Willd.*, Catabrosa aquatica *Beauv.*, Cirsium arvense *Scop.*, Cotoneaster microphylla *Wall.*, Cotoneaster vulgaris *Lindl.*, Cratægus oxycantha *Linn.*, Gymnema latifolium *Wall.*, Gynocardia odorata *R.Br.*, Hydrangea aspera *Buch.*, Indigofera galegoides *DC.*, Ipomæa dissecta *Willd.*, Ipomæa sinuata *Ort.*, Isopyrum thalictroides *Linn.*, Lamarkia aurea *Mœnch.*, Linaria minor *Desf.*, Linum usitatissimum *Linn.*, Lotus corniculatus *Linn.*, Lepidium draba *Linn.*, Lycium barbarum *Linn.*, Manihot utilissima *Pohl.*, Melica ciliata *Duthie.*, Modecca wightiana *Wall.*, Papaver nudicaule *Linn.*, Phaseolus lunatus *Linn.*, Photinia serratula *Lind.*, Prunus amygdalus *Baill.*, Prunus padus *Linn.*, Prunus puddum *Roxb.*, Prunus undulata *Ham.*, Pyrus aucuparia *Gærtn.*, Pyrus cydonia *Linn.*, Ranunculus arvensis *Linn.*, Ribes grossularia *Linn.*, Ribes rubrum *Linn.*, Sambucus ebulus *Linn.*, Sambucus nigra *Linn.*, Schleichera trijuga *Willd.*, Solanum tuberosum *Linn.*, Sorghum halepense *Pers.*, Sorghum saccharatum *Pers.*, Sorghum vulgaris *Pers.*, Spiræa aruncus *Linn.*, Spiræa lindleyana *Wall.*, Stipa tortilis *Linn.*, Stranvæsia glaucescens *Lindl.*, Taraktogenos kurzii *King.*, Trifolium repens *Linn.*, Triglochin maritimum *Linn.*, Triglochin palustris *Linn.*, Vicia hirsuta *Koch.*, Vicia sativa *Linn.*, var. augustifolia *Roth.*

PLANTS CONTAINING ARSENIC

Allium porrum *Linn.*, Ananas sativa *Linn.*, Avena sativa *Linn.*, Cicer arietinum *Linn.*, Cichorium intybus *Linn.*, Citrus aurantium *Linn.*, Cucurbita pepo *DC.*, Daucus carota *Linn.*, Ervum lens *Linn.*, Hedera helix *Linn.*, Hordeum vulgare *Linn.*, syn. H. sativum *Pers.*, Juglans regia *Linn.*, Lactuca sativa *Linn.*, Linum usitatissimum *Linn.*, Nasturtium officinale *R.Br.*, Nicotiana tabacum *Linn.*, Oryza sativa *Linn.*, Pisum sativum *Linn.*, Prunus amygdalus *Baill.*, Raphanus sativus

Linn., Spinacia oleracea *Linn.*, Tragopogon pratense *Linn.*, Trifolium pratense *Linn.*, Triticum sativum *Linn.*, Vicia faba *Linn.*, Vicia sativa *Linn.*, Viscum album *Linn.*, Vitis vinifera *Linn.*, Zea mays *Linn.*

PLANTS CONTAINING OXALIC ACID

Æsculus hippocastanum *Linn.*, Amarantus caudatus *Linn.*, Calamus droco *Willd.*, Camellia theifera *Griff.*, Cassia angustifolia *Vahl.*, Cinchona succirubra *Pav.*, Cratægus oxycantha *Linn.*, Galium mollugo *Linn.*, Juglans regia *Linn.*, Juniperus communis *Linn.*, Lycopersicum esculentum *Mill.*, syn. Solanum lycopersicum *Linn.*, Nicotiana tabacum *Linn.*, Oxalis acetosella *Linn.*, Papaver somniferum *Linn.*, Phalaris canariensis *Linn.*, Plygonum bistorta *Linn.*, Rheum emodi *Wall.*, Rubus fruticosus *Linn.*, Rumex acetosella *Linn.*, Saccharum officinarum *Linn.*, Salsola kali *Linn.*, Sambucus nigra *Linn.*, Solanum tuberosum *Linn.*, Tamarindus indica *Linn.*, Vitis vinifera *Linn.*, Zingiber officinale *Rosc.*

PLANTS CONTAINING BARIUM

Juglans regia *Linn.*, Nicotiana tabacum *Linn.*, Prunus avium *Linn.*, Ulmus campestris *Linn.*

PLANTS CONTAINING LEAD

Molinia cœrulea *Mœnch.*, Randia dumetorum *Lamk.*, Vicia faba *Linn.*

PART V

THE COMMON BAZAR MEDICINES OF INDIA

Abelmoschus esculentus W. & A.

VERN.—Sans.—*Gandhamula, Tindisa* ; Hind. & Punj.—*Bhindi* ; Beng.—*Dheras* ; Bomb.—*Bhénda* ; Tam. & C. P.—*Bhendi* ; Tel.—*Venda-kaya* ; Guz.—*Bhindu* ; Malay—*Ventak-kaya* ; Sing. -*Bhandaká* ; Burm.—*Youn-padi si* ; Arab.—*Bámiyá* ; Pers.—*Bámiyah*.

It grows abundantly throughout India. The bland viscid mucilage has emollient and demulcent properties. A decoction of the fresh unripe capsule is administered in gonorrhœal cystitis and urethritis and in other conditions where there is difficulty in micturition. In dysentery, the mucilage is beneficial. The vapour from the hot decoction is used as an inhalation in irritable condition of the throat and in troublesome cough of phthisis.

Abies webbiana Lindl.

VERN.—Sans., Hind. & Beng.—*Talisapatra* ; Kashmir—*Bádar* ; Garhwal—*Chili rágha, Morunda* ; Kumaon—*Ragha* ; Nepal—*Gobria sulah* ; Bhutia—*Dumshing*.

This is a lofty tree growing in the Himalayan ranges. The leaves, in the form of decoction or infusion, are used in chronic bronchitis, phthisis and other pulmonary affections. There is a great deal of confusion about the vernacular name 'talispatra' given to it. The drug dealers sell leaves and young shoots of many other plants such as *Taxus baccata* for *A.webbiana* and it is difficult to recognise the true drug on the market.

Abroma augusta Linn. (see page 261).

Abrus precatorius Linn. (see page 262).

Abutilon indicum G. Don.

VERN.—Hind.—*Kanghani, Kanghi* ; Beng.—*Potári* ; Bomb.—*Kangori, Kangoi* ; Tam.—*Perun-tutti* ; Tel.—*Tutiri-chettu* ; Guz.—*Dábali* ; Cutch—*Balbij* ; Sind.—*Khápato* ; Goa—*Petári* ; Malay—*Tutta* ; Kan.—*Shrimudrigida* ; Sing.—*Anoda-gaha* ; Burm.—*Bon-khoye* ; Arab—*Masht-ul-ghoul* ; Pers.—*Darakhte-shanah*.

It is common throughout the hotter parts of India. The bark, the root, leaves and seeds of the plant have all been used in medicine. The leaves when soaked in water yield a mucilage which has been used as a diuretic and demulcent in fever and chest affections and

also in gonorrhœa and urethritis. The seeds, finely powdered, can be given in doses of 1-2 drachms as a laxative and expectorant.

Acacia arabica Willd.

VERN.—Sans.—*Vabbúla* : Hind., Beng. & Punj.—*Báblá, Kikar* ; Bomb.—*Babhula* ; Tam.—*Karú-velum* ; Tel.—*Túma* ; Guz.—*Bával* ; Sind.—*Babhúla* ; Mal.—*Babola* ; Kan.—*Jáli* ; Arab—*Ummughílán* ; Pers.—*Kháré-mughílán.*

It occurs throughout India in dry and sandy localities. The bark (Babul bark) is an excellent astringent and is largely used in the form of decoction in chronic diarrhœa. Its chief uses are as a local astringent douche in leucorrhœa and vaginal discharges, as an enema in piles and prolapse of anus, and as a gargle in foul and aphthous stomatitis. Babul bark in combination with Mango bark, boiled for about half an hour in a pint of water forms a good preparation for mouth wash. The tree yields a gum which is an efficient substitute for true gum acacia.

Acacia catechu Willd.

VERN.—Sans.—*Khadira* ; Hind.—*Khair, Katha* ; Beng.—*Khayer* ; Bomb.—*Khaderi, Khaira* ; Tam.—*Wothalay* ; Tel.—*Kaviri sandra* : Guz.—*Kher* ; Santal—*Khaiyar* ; Assam—*Khoira* ; Uriya—*Khoiru* ; Sing.—*Ratkihiri* ; Burm.—*Sha.*

Catechu is the resinous extract obtained by boiling down a decoction of wood of *A. Catechu.* It occurs in dark brown masses with a very astringent taste. The lighter variety is an imported one from Malaya and Singapore and is derived from *U. gambier.* It is given in diarrhœa in doses of 5-15 grs., alone or combined with cinnamon or opium. In ulceration of the gums, sore throat and toothache, a small piece of catechu made into the shape of a lozenge with cinnamon and nutmeg is sometimes useful and has been advocated by the Hindu physicians. An ointment, 1 drachm to an ounce of vaseline or lard is a good local application for ulcers.

Acalypha indica Linn.

VERN.—Sans.—*Arittamunjayrie* ; Hind. & Bomb.—*Khokalí* ; Beng. —*Muktajuri* ; Tam.—*Kuppaimeni* ; Tel.—*Harita-manjiri* ; Guz.—*Vanchhi kánto* ; Uriya—*Indra-maris* ; Mar.—*Khokli* ; Sing.—*Kupamenya.*

It is a common shrub generally growing in the waste places throughout the plains of India. The root, leaves and young shoots are used medicinally. It is a favourite remedy in chronic bronchitis and consumption. One drachm of the expressed juice of the leaves should be given to children. An infusion of the root acts as a cathartic.

The juice from fresh leaves may be employed in scabies and other skin diseases, and with lime and onion, it is a good stimulating application in rheumatism.

Achillea millefolium Linn.

VERN.—Bomb.—*Rojmarí* ; Cutch.—*Biranjasif* ; Kash.—*Momádrú chopándiga* ; Afg.—*Búí máderán*.

This herb abounds in the Himalayas from Kashmir to Kumaon. The powdered leaves and flower-heads are useful as carminative and tonic in 5-30 grains doses. A hot infusion of the leaves is a powerful emmenagogue.

Achyranthes aspera Linn.

VERN.—Sans.—*Apámárga* ; Hind.—*Latjírá* ; Beng.—*Apáng* ; Bomb. & Mar.—*Aghádá* ; Punj.—*Kutri* ; Tam.—*Ná-yurivi* ; Tel.—*Apa márgamu* ; Mal.—*Kataláti* ; Guz.—*Aghedo* ; Arab.—*Atkumah* ; Pers.—*Kháre-vázhún* ; Burm.—*Kune-lá-mon*.

It is a small herb very common throughout India. The flowering spikes or the seeds of the plant, grounded and made into a paste with water have been used as an external application for bites of poisonous snakes and reptiles. Decoction of the whole plant is a good diuretic and is given in renal dropsy and general anasarca. For preparation of the decoction, about 2 ounces of the plant in one and a half pint of water should be boiled for 20 minutes to half an hour and then strained. One to two ounces of the mixture is given two or three times daily. The astringent property of the drug has also been noticed by some. A decoction of the powered leaves with honey or sugar candy, is useful in the early stages of diarrhœa and dysentery.

Aconitum (see page 47).

Acorus calamus Linn. (see page 264).

Adhatoda vasica Nees. (see page 265).

Adiantum capillus-veneris Linn.

VERN.—Hind.—*Hansráj, Mubáraka* ; Kash.—*Dumtúlí* ; Kumaon —*Mubáráka* ; Arab.—*Shair-ul-jin* ; Pers.—*Sir siá-peshâne* ; Guz.—*Hanspadi*.

It is known as Maiden-hair fern. It is chiefly obtained in the Punjab bazars and can also be had in some parts of Southern India. The expressed juice with pepper is a favourite remedy in all kinds of fever. A syrup prepared from the leaves is useful in chronic cough.

Ægle marmelos Corr. (see page 269).

Alangium lamarckii Thw. (see page 272).

Allium cepa Linn.

VERN.—Sans.—*Palándu* ; Hind. & Pers.—*Piyáz* ; Beng.—*Piyaj* ; Bomb.—*Piyaj, Kanda* ; Tam.—*Irulli* ; Tel.—*Nírulli* ; Guz. & Sind.—*Dúngari* ; Assam—*Piyás* ; Kan.—*Nirulli* ; Mal.—*Bawang* ; Sing.—*Lúnú* ; Burm.—*Kesun-ni* ; Arab.—*Basl.*

Onion is widely cultivated throughout India and is largely consumed as a food. Two varieties—Bombay and Patna—are obtainable in Bengal, the latter being of superior kind. Externally, onion has been used to allay the irritation due to the bites of scorpion and other insects and mixed with mustard oil it is useful in rheumatic and other joint troubles and in skin diseases. Internally, it has been used as a stimulant, expectorant and aphrodisiac.

Allium sativum Linn. (see page 273).

Alocasia indica Schott.

VERN.—Sans.—*Mánaka* ; Hind.—*Mánkanda* ; Beng.—*Mánkachú* ; Mar.—*Alú.*

The underground stem of this plant is a common domestic remedy in gout and rheumatism. Dr. Kanai Lal Dey gives a formula for a preparation, which is called '*manmanda.*' Powdered *Alocasia indica* 3 ounces, powdered rice 6 ounces, water and milk 20 ounces, boiled and given in doses of 1-2 ounces in cases of gout, rheumatism and dropsy.

Aloes (see page 57).

Alstonia scholaris R. Br. (see page 278).

Alum.

VERN.—Sans.—*Sphatikari* ; Hind.—*Phitkari* ; Beng.—*Phatkiri* ; Tam.—*Pati-káram* ; Tel.—*Pati-kárám* ; Mar.—*Phatki* ; Mal.—*Patik-káram* ; Burm.—*Keo-khin* ; Arab.—*Záj* ; Pers.—*Záke-safed.*

It is procurable in the bazar in colourless, transparent crystalline masses. Alum is a valuable astringent gargle in sore throat, ulceration of the mouth and gums in a strength of 2 drachm to a pint of decoction of gall or Babul bark or of plain water. The following combination is useful as a local application for gangrenous ulcers. Finely powdered alum 4 drachms, finely powdered catechu 1 drachm, opium $\frac{1}{2}$ drachm, kokum butter or ghee 1 ounce. Alum lotion has also been highly valued in traumatic swellings of joints and in bites of insects. 3-6 grains of alum in one ounce of distilled water is used as an eye lotion in chronic conjunctivitis. Internally, it is

administered to check hæmorrhage from lungs, stomach, kidney and other organs or to arrest excessive menstrual flow. A preparation known as 'lime whey', is a popular remedy and is prepared by boiling for ten minutes, 2 drachms of powdered alum in a pint of milk and then straining. As a hæmostatic, its use is recommended in bleeding from the nose and other mucous surfaces. In chronic diarrhœa, the following mixture will be found useful:—alum 10 grains, laudanum 5 drops, infusion of acorus root 1½ ounces.

Ammonii chloridum.

VERN.—Sans.—*Navasara* ; Hind.—*Nousádar* ; Beng.—*Nishadal* ; Mar.—*Navságar* ; Tam.—*Nava-charum* ; Tel.—*Navá-chárum* ; Guz.—*Navaságar* ; Mal.—*Nava-sáram* ; Arab.—*Milhunnár* ; Pers.—*Nóshádar* ; Sing.—*Naváchárum* ; Burm.—*Zarasa.*

The bazar 'sal ammoniac' is generally impure. Most of the stuff that comes to the bazar in India is manufactured from a kind of clay found at Karnal in the Punjab. As a local application, it is useful in threatening mammary abscess, sprains, rheumatism, lumbago, sciatica, and headache. In hysteria, nervousness, jaundice and other liver complaints and gastric catarrh, doses of 10-20 grains three times daily are beneficial. It is often prescribed as a stimulating expectorant in chronic bronchitis and in pneumonia in the stage of resolution.

Amomum subulatum Roxb.

VERN.—Sans.—*Brihat-upakunchiká* ; Hind.—*Bari-iláchí* ; Beng.—*Bara-elachi* ; Tam.—*Periya-yélakkáy* ; Tel.—*Pedda-yéla-káyálu* ; Kan.—*Doddá-yalakkí* ; Mar.—*Moté-veldode* ; Mal.—*Periya-elattari* ; Guz.—*Moto-ilachi* ; Burm.—*Pala* ; Arab.—*Qákilhahe-kibár* ; Pers.—*Qákilahe-kalán.*

It is a native of Nepal. Owing to its cheapness, it is frequently employed in place of *Elettaria cardamomum*—the true cardamom. The seeds are stomachic, carminative and stimulant.

Anacyclus pyrethrum DC.

VERN.—Sans.—*Akara karava* ; Hind., Beng. & Bomb.—*Akarkará* ; Tam. & Tel.—*Akkirakáram* ; Mar.—*Akkalkádhá* ; Kan.—*Akkala-karé* ; Guz.—*Akorkaro* ; Arab.—*Aquarqarha.*

The root of the plant is regarded as a tonic to the nervous system and has been given in paralysis, hemiplegia, epilepsy, chorea and a host of other diseases. From its property as a sialagogue, it has been frequently administered to backward children in the Deccan to make them talk. Such a belief is unfounded. A decoction of the root will be found useful as a gargle in carious teeth, sore throat and tonsillitis.

Ananas sativa Linn.

VERN.—Hind.—*Anannas* ; Beng.—*Anáras* ; Mar. & Guz.—*Anánas* ; Tam.—*Anáshap-pazham* ; Tel.—*Anása-pandu* ; Kan.—*Anánasu-hannu* ; Mal.—*Annanas* ; Arab. & Pers.—*Aainunnás* ; Sing.—*Annási* ; Burm.—*Nanna-ti.*

The pineapple is a very common fruit in the bazar. It is not truly indigenous but has been introduced from Brazil. The juice of the fresh leaves mixed with sugar is regarded as anthelmintic and purgative. The fruit itself is largely consumed and is believed to possess antiscorbutic properties.

Andrographis paniculata Nees. (see page 280).

Andropogon citratus DC.

VERN.—Sans.—*Bhústrina* ; Hind.—*Aginghás, Gandha trina* ; Beng.—*Gandha bená* ; Mar.—*Olancha* ; Guz.—*Lilichá* ; Tam.—*Vashanup-pulla* ; Tel.—*Chippa-gaddi* ; Kan.—*Púr-hali-hulla* ; Pers.—*Cháe-kashmiri* ; Sing. —*Penquin.*

The lemon grass grows throughout India. The oil distilled from the leaves of A. *citratus* is the commonly known 'lemon grass oil' which is used medicinally. The oil obtained from *A. muricatus, A.nardus* and *A.schœnanthus* is a valuable product of perfumery and is not used in medicine. Lemon grass oil is sherry coloured with a pungent taste and lemon-like odour. Three to six drops of the oil either with sugar or in emulsion act as carminative in flatulence, colic and obstinate vomiting. A decoction made from the leaves is recommended as a diaphoretic in fever. Locally applied in rheumatism, lumbago and sprains, it is a good embrocation and affords relief.

Anethum sowa Roxb. (see page 218).

Anthemis nobilis Linn.

VERN.—Hind.—*Bábuni-ke-phul* ; Tam.—*Shímai-chamantipú* ; Tel.—*Sima-chamanti-pushpam* ; Mal.—*Shíma-jevanti-pushpam* ; Kan.—*Shíme-shyámantige* ; Arab.—*Bábúnaj* ; Pers.—*Bábúnah.*

This plant is a native of Europe but is to some extent cultivated in the Punjab. Chamomile flowers in the form of infusion is carminative. It has been found useful in hysteria and dysmenorrhœa. A warm infusion can be used as anthelmintic for children.

Areca catechu Linn. (see page 283).

Argemone mexicana Linn. (see page 286).

Aristolochia bracteata Retz.

VERN.—Sans.—*Dhumrapatra, Pattrabunga*; Hind.—*Kirámár*; Bomb.—*Kidámári*; Tam.—*Adutina-pálai*; Tel.—*Kadapara*; Mal.—*Atutintáppála*; Uriya—*Paniri*.

It grows along the banks of the Ganges and is also met with in Southern India. Every part of the plant has been used in medicine and is extremely bitter. An infusion prepared from about ½ an ounce of the dried plant in 10 ounces of water is regarded as anthelmintic and emmenagogue; dose 1 to 2 ounces. Powdered dry root in doses of 1-2 drachms is said to increase the contractions of uterus during labour and is used in Sind as a substitute for ergot.

Aristolochia indica Linn.

VERN.—Sans.—*Rudrajata*; Hind.—*Isharmul*; Beng.—*Isarmul*; Bomb. & Mar.—*Sápasan*; Cutch & Guz.—*Ruhimula*; Goa—*Sápús*; Tam.—*Ich-chura-múli*; Tel.—*Ishvara-véru*; Mal.—*Ishvará múri*; Kan.—*Ishvéri-vérú*; Santal—*Bhedi janetet*; Arab. & Pers.—*Zarávande-hindi*.

It grows nearly all over India. The root and the stem are generally available from the drug dealers. The taste is bitter with a slight smell like camphor. Decoction of the root and the stem in doses of 1-2 ounces is stimulant, tonic and febrifuge. With black pepper and ginger, it is used as a carminative in diarrhœa and various forms of bowel complaints. Fresh juice of the leaves is a favourite antidote to bites of poisonous snakes. The root has been used for criminal abortion.

Asparagus adscendens Roxb.

VERN.—Hind.—*Sufėd-musli*; Bomb.—*Sápheta musali*; Guz.—*Saphéd-musli*; Mar.—*Saféda musali*; U. P.—*Khairuwa*; Arab. & Pers.—*Shaqáqule-hindi*.

It is found in Bombay, Rohilkhand, Oudh and some other parts of India. The dried tuberous roots obtained in the bazar are known as 'safed musli'. The colour of the tubers is white and they swell up with water. They have got excellent cooling and demulcent properties and are frequently administered with boiled milk and sugar in diarrhœa and dysentery.

Asparagus sarmentosus Willd.

VERN.—Sans.—*Satavari*; Hind.—*Shakákul, Satavari*; Beng.—*Satamuli*; Bomb.—*Shatavari*; Tam.—*Kilávari*; Tel.—*Challa gaddalu*; Guz.—*Shatávarí*; Sind.—*Tilora*; Mar.—*Satáva-ri-múl*; Mal.—*Shatavali*; Assam.—*Hatmuli*; Sing.—*Hatávari*; Burm.—*Kanyo-mi*.

This species of plant is found generally in Northern India and is sometimes substituted for *A.adscendens* as 'safed musli'. The root,

on account of its high mucilagenous content is used as a demulcent and as a tonic in all devitalizing conditions. Boiled with some bland oil, the root has been used in various skin diseases.

Asteracantha longifolia Nees.

VERN.—Sans.—*Kokilāksha ;* Hind.—*Tálmakhána ;* Beng.—*Káliá-khárá ;* Bomb.—*Tálimkhana ;* Tam.—*Nirmalli ;* Tel.—*Nirguvi veru ;* Santal—*Gokhula janum ;* Guz.—*Gokhru ;* Mal.—*Bahel-schulli ;* Sing.—*Katre-iriki.*

The root is specially prized as a valuable diuretic in dropsy. The following mixture has been advised by Dr. Kanai Lal Dey:—freshly dried leaves 2 ounces, vinegar 10 ounces, macerate for three days, press and strain. Dose 1 to 3 tablespoonfuls thrice daily.

Atropa belladonna Linn. (see page 66).

Azadirachta indica Juss. (see M. azadirachta *Linn.*, page 340).

Baliospermum montanum Muell.

VERN.—Sans., Hind. & Beng.—*Dánti ;* Bomb.—*Dantimul ;* Tel.—*Adavi-ámudan ;* U. P.—*Jangli jamalgota ;* Arab.—*Habbussala ;* Pers.—*Bédanjire-khatái ;* Lepcha—*Poguntig.*

It is one of the commonest drugs of North and East Bengal reaching as far as Burma. The root is sold as 'dantimul' by the drug dealers. The seeds have properties more or less similar to *Croton tiglium* and are employed as a drastic purgative. Locally the seeds *act as stimulant and rubifacient. The root and the leaves have similar* properties and are used in the indigenous medicine in dropsy and general anasarca.

Balsamodendron mukul Hook. (see page 287).

Balsamodendron myrrha Nees.

VERN.—Sans.—*Rasagandha ;* Hind.—*Ból ;* Beng.—*Gandharash ;* Tam.—*Vellaip-pólam ;* Tel.—*Bálimtra-pôlam ;* Guz. & Cutch—*Hirábol ;* Kan.—*Bôlá ;* Sing.—*Bólam ;* Arab.—*Murr ;* Pers.—*Ból.*

Myrrh of commerce is obtained from the resinous exudation of the tree *B.myrrha.* Quite a large quantity of myrrh is imported into Bombay from East Africa, Arabia, Persia and Siam. There are at least two or three varieties, two of them being known as 'Karam' and 'Mutiya'. The bazar variety is heavily adulterated and substituted by other allied species. Myrrh is a good astringent mouth wash in stomatitis and sore throat. It is a stimulating expectorant and can be advantageously administered in chronic bronchitis and phthisis.

Tincture of myrrh is useful in menstrual disorders and chlorosis of young girls.

Bambusa arundinacea Retz.

VERN.—Sans.—*Vansa* ; Hind. & Beng.—*Báns* ; Bomb.—*Mandgay* ; Punj.—*Magar* ; Tam.—*Mangal* ; Tel.—*Bónga* ; Guz.—*Wans* ; Konkan—*Kalak* ; Santal—*Mat* ; Assam—*Buáh* ; Sing.—*Una* ; Burm.—*Kyakatwa* ; Arab—*Qasab* ; Pers.—*Nai.*

Bamboo is one of the commonest plants in India. Apart from its commercial importance in paper industry and in building huts and cottages, it has found some place in the indigenous medicine owing to the presence of a substance known as 'Bansolochana' in Sanskrit or as 'Tabashir' in Persian. 'Bansolochana' is a siliceous deposit in the interior of the stem of *B.arundinacea.* Two varieties are available in the market, the blue and the white, both having a sweet taste. It is much prized as a stimulant and febrifuge. In paralytic complaints, asthma, cough and other debilitating diseases, the drug is greatly valued in the indigenous medicine. The young leaves, in the form of a decoction combined with some aromatic substance, have also been used as an emmenagogue.

Bassia latifolia Roxb. and **B. longifolia** Linn. (see page 289).

Berberis (see page 291).

Blumea lacera DC. (see page 113).

Bœrhaavia diffusa Linn. (see page 300).

Borassus flabelliformis Murr.

VERN.—Sans.—*Tála* ; Hind.—*Taltar, Tal* ; Beng.—*Tál* ; Tam.—*Panna-maram* ; Tel.—*Táti-chettu* ; Guz.—*Tád* ; Mar.—*Talat-mád* ; Mal.—*Paná* ; Santal—*Tale* ; Sing.—*Tal* ; Burm.—*Tan* ; Pers.—*Darakhte-tári.*

It is a tall palm growing in the sandy localities along the river banks. The juice of the plant is taken as a stimulant beverage and has some laxative property. By the fermentation of this juice, an intoxicating liquor (toddy) is prepared which is a favourite drink among the labouring classes. Toddy poultice, prepared in combination with flour of rice is a stimulating application to inflammed parts. The expressed juice from the young terminal buds and the decoction of the root have been used in gastritis and hiccough.

Brassica juncea Hk. f. & T.

VERN.—Sans.—*Rájiká* ; Hind.—*Rái, Sarsón* ; Beng.—*Rái sarishá* ; Bomb.—*Rai* ; Mar.—*Ráyán* ; Kash.—*Asúr* ; Sing.—*Abba.*

Brassica juncea is the common Indian mustard and is largely employed medicinally along with black mustard, *Brassica nigra.* Mustard poultice prepared with cold water forms an excellent counter-irritant in many inflammatory and neuralgic affections, in abdominal colic and obstinate vomiting. In no case the plaster should be in contact with the skin for more than ten minutes. One or two tea-spoonful of mustard in water, is an efficient emetic to empty the stomach in cases of poisoning. A hot mustard bath is an emmenagogue.

Butea frondosa Roxb. (see page 305).

Cæsalpinia bonducella Fleming. (see page 307).

Calci hydroxide.

VERN.—Sans.—*Chúrna ;* Hind.—*Chúná ;* Beng.—*Chún ;* Punj.—*Kalai ;* Guz.—*Chuno ;* Tam.—*Chúnámbú ;* Tel.—*Súnna ;* Arab.—*Kils, Ahú ;* Pers.—*Núrah ;* Burm.—*Thón-phiyu.*

C. oxide.

VERN.—Hind.—*Kalika-chuná ;* Tam.—*Kar-shunnambu ;* Tel.—*Ralla sunnamu ;* Punj.—*Chúnah.*

Calcium is a well-known remedy in all inflammatory swellings. It is popularly used in the form of lime water. Lime water is prepared by adding two ounces of slaked lime to a gallon of water and decanting off the supernatant clear fluid after the whole mixture has been allowed to stand for a time. In combination with some bland oil lime water forms a good emollient in burns and scalds, skin diseases, sore nipple etc. About 3 ounces of lime water as an enema is found quite effective in threadworms in children. Given internally it forms a good antacid in dyspepsia and heart burn. In obstinate vomiting and diarrhœa, vomiting of children, in consumption, in poisoning by mineral acids, lime water is a handy and really useful remedy. An elegant way of prescribing lime water is to give it in combination with milk, 4 or 5 ounces being added to a pint of milk.

Calophyllum inophyllum Linn.

VERN.—Sans.—*Punnága ;* Hind.—*Sultána champa, Surpunka ;* Beng.—*Punnág ;* Bomb.—*Undi ;* Mar.—*Surangi, Nágchámpa ;* Tam.—*Punnágam ;* Tel.—*Pumágamu, Ponna-chettu ;* Cutch—*Udi ;* Sing.—*Domba ;* Mal.—*Betan ;* Burm.—*Pongnyet.*

The leaves of this tree are employed in eye diseases. The bark is astringent and a decoction of it is used as a wash for indolent ulcers. The kernel of the seeds yields a dark yellow oil which is used commonly as lamp-oil and medicinally as a stimulant application in rheumatism.

Calotropis gigantea and **C. procera** R. Br. (see page 309).

Calycopteris floribunda Lamk.

VERN.—C. P.—*Kohoranj* ; Mar.—*Ukshi* ; Tel.—*Bandimurudu-du* ; Mysor.—*Marsada boli*.

It is a large shrub growing in Central India, the Deccan and Assam. The juice from the young twigs is used in diarrhœa and dysentery. Dr. Koman of Madras advocated its use as an anthelmintic and laxative.

Camellia theifera Grift. (see page 68).

Cannabis sativa Linn. (see page 73).

Capsicum annum Linn. and other species.

VERN.—Hind. & Punj.—*Mattisa, Mirch* ; Beng.—*Lanka-marich, Gách-marich* ; Kumaon.—*Mattisa-wangrú* ; Kash.—*Mirch-wángum* ; Guz.—*Marchu* ; Mar.—*Mairsingá* ; Tam.—*Milagáy* ; Tel.—*Mirapa-singá* ; Mala.—*Kappal-melaka* ; Sans.—*Marichi-phalam* ; Arab.—*Ahmur* ; Pers. —*Filfile-surkh* ; Sing.—*Miris* ; Burm.—*Na yop*.

Chillies are used daily as condiment and are grown abundantly throughout India. The three important varieties of capsicum, *C.annum, C.fastigiatum* and *C.minimum* differ in size, shape and colour. When applied locally they produce blisters and the fresh fruits made into a paste in combination with mustard are used as counter-irritant. They have been used as a gargle in sore throat and hoarseness and internally, in dyspepsia and loss of appetite, as useful adjunct to aloes. A pill made of capsicum, ginger and rhubarb is carminative and may be advantageously employed in atonic dyspepsia.

Cardiospermum halicacabum Linn.

VERN.—Sans.—*Káravi* ; Beng.—*Lataphatkari* ; Punj.—*Habul-kalkal* (seed) ; Guz.—*Karotio* ; Bomb.—*Bodha* ; Tam.—*Múda-cottan* ; Tel.—*Búdha-kakara* ; Burm.—*Ma-la-mai* ; Arab.—*Laftaf* ; Sing.—*Painaira-wel*.

This plant is plentiful in every part of India. A decoction of the root in doses of 4 to 6 ounces is considered as a diuretic, diaphoretic and laxative. Dr. U. C. Dutt recommends the following preparation as an emmenagogue. Equal parts of leaves of *C.halicacabum*, potassium carbonate, root of *Acorus calamus* and root bark of *Terminalia tomentosa* are rubbed into a paste with milk. One drachm of the preparation daily is said to effect a free menstrual flow in about three days. The whole plant has also been used both internally and externally in rheumatism and lumbago.

Carica papaya Linn. (see page 311).

Carum carui Linn. (see page 80).

Carum copticum Benth. (see page 81).

Caryophyllus aromaticus Linn. (see page 86).

Cassia alata Linn.

VERN.—Sans.—*Dadrughna* ; Beng.—*Dádmári* ; Hind.—*Dádmurdan* ; Mar.—*Dádamardana* ; Tam.—*Shimai-agati* ; Tel.—*Sima avisl* ; Kan.—*Shime-agase* ; Sing.—*Attora* ; Burm.—*Maizali-gi.*

This is a common handsome shrub with yellow flowers. The bruised leaves, applied locally in the form of an ointment, have a great reputation in skin diseases and are regarded as a specific for ringworm.

Cassia auriculata Linn.

VERN.—Hind.—*Tarwar* ; Mar.—*Taravada* ; Guz.—*Awal* ; Tam.—*Avári* ; Tel.—*Tangédu* ; Cutch.—*Awala* ; Kan.—*Taravadagida* ; Mal.—*Avára* ; Sing.—*Rana-vara.*

It is called the tanner's cassia, as the bark is one of the most valuable of Indian tans. Finely powdered, decorticated seeds have been used as a dusting powder in conjunctivitis. The bark is considered astringent; it has been much used as a gargle in sore throat in place of oak gall and seems to be worthy of trial. A decoction of the whole plant or the flower buds has been tried in diabetes.

Cassia lanceolata Linn. (see C. angustifolia page 87).

Cephalandra indica Naud. (see page 313).

Cera *alba* and **C. *flava*** (Wax).

VERN.—Sans.—*Madhujan* ; Hind., Beng., Dec. & Pers.—*Móm* ; Kash.—*Sinth* ; Guz.—*Min* ; Mar. & Kan.—*Ména* ; Tam.—*Méllugú* ; Tel.—*Mai-nam* ; Sing.—*Itti* ; Arab.—*Shama* ; Burm.—*Phayouii.*

Wax has got very little medicinal property. Its chief use is as a plaster and as a basis for ointments. The following preparation is considered to be an effective application to boils. Equal quantities of *Balsamodendron mukul, B. pubescens,* wax and sesame oil are melted together and is applied over the affected part in the form of a plaster.

Cerbera thevetia Don. (see Thevetia neriifolia *Juss.*, page 405).

Chenopodium (see page 89).

Chenopodium album Linn.

VERN.—Sans.—*Vastuk* ; Hind. & Beng.—*Bathú-sag, Chandan betu* ; Punj.—*Bathúa* ; Tam.—*Parupu kire* ; Tel.—*Pappu kura* ; Bomb.—*Chakwit* ; Sind.—*Jhil* ; Arab.—*Kulf*.

It is widely grown throughout India, in the plains and also in the hilly tracts of Kashmir and Sikkim. The leaves of the plant are taken in the form of infusion or decoction, as a laxative and anthelmintic. The seeds are consumed by the hill tribes as an article of food. It has been recommended by the Hindu physicians in hepatic disorders and in splenic enlargement.

Cichorium intybus Linn.

VERN.—Hind. & Pers.—*Kasni* ; Tam.—*Kashini-virai* ; Tel.—*Kasini-vittulu* ; Punj.—*Gúl* ; Arab.—*Hindyba* ; Guz.—*Kásani.*

In the Punjab plains and in Kashmir, chicory is cultivated as a fodder, and the roots and seeds are very common drugs of the Punjab bazars. The root is dried, powdered and mixed with coffee as an adulterant. It has also been described as a useful medicine in congestion of the liver and resembles taraxacum in its pharmacological properties. The powdered seeds can be employed in disorders of menstruation.

Cinnamomum camphora Nees. (see page 113).

Cinnamomum zeylanicum Breyn. (see page 117).

Cissampelos pareira Linn.

VERN.—Sans.—*Ambashthái-páthá;* Hind.—*Akanádi;* Beng.—*Akanádi;* Bomb.—*Venivel* ; Punj.—*Katori, Batbel* ; Tam.—*Pomúshtic* ; Tel.—*Pata* ; Nepal.—*Batúlpoti.*

The dried root of the plant is a common bazar drug. It is a substitute for true pareira which is imported from South America. An extract or decoction of the root is used as a diuretic in acute and chronic cystitis and urethral discharge. The root extract has also been advocated in bowel complaints. The leaves made into a paste with some bland oil have been used in sores and itches.

Citrullus colocynthis Schrad. (see page 121).

Citrus aurantium Linn.

VERN.—Sans.—*Nágaranga* ; Hind.—*Nárangi, Kumla nebu* ; Beng.—*Kamlá nembu* ; Punj.—*Santara* ; Bomb.—*Náringi* ; Tam.—*Kitchli* ; Tel.—*Ganjanimma* ; Arab.—*Náranj* ; Pers.—*Nárang* ; Burm.—*Thau-ba-ya.*

The orange is cultivated principally in the Khasia hills in Assam and in the Central Provinces which are the two sources of supply to the Indian market. The fruit is largely consumed and is a valuable antiscorbutic. The rind of orange, in the form of infusion or tincture. is a valuable stomachic, and carminative in dyspepsia, flatulance and gastric irritabilities in general. Powdered orange peel, magnesium carbonate and rhubarb form a useful carminative preparation.

Citrus medica Linn. (see page 123).

Cleome viscosa Linn.

VERN.—Sans.—*Aditya bhakta* ; Beng.—*Húr-húria* ; Hind.—*Húrhúr* ; Punj.—*Húl húl* ; Bomb.—*Kánphúti* ; Tam.—*Nahi-kuddaghu* ; Tel.—*Kukha-avalu.*

It grows commonly throughout India. The juice of the leaves mixed with warm ghee is used in earache and inflammation of the middle ear. The seeds resemble mustard seeds in action and a poultice made with lime water, vinegar and warm water is efficiacious in chronic painful joints as a counter irritant. The powdered seeds are employed in doses of ½ to 1 drachm twice daily as an anthelmintic.

Clerodendron infortunatum Gœrtn.

VERN.—Sans.—*Bhándíra* ; Beng.—*Ghetú* ; Punj.—*Káli basúti* ; Bomb.—*Kari* ; Mar.—*Bhandira* ; Tel.—*Bockada* ; Kan.—*Nayi-bela* ; Nepal.—*Chitu.*

C. infortunatum is a common shrub with pinkish flowers growing throughout the waste-land areas in India and also in Ceylon. The juice of the leaves has for a long time been used as an antiperiodic in malaria in doses of 1-2 ounces. Though definite antimalarial properties have not been demonstrated, it is a good bitter tonic after attacks of ague. Decoction of the leaves has been used as an anthelmintic in roundworm infection.

Coffea arabica Linn.

VERN.—Hind.—*Coffi*, Beng.—*Kapi* ; Bomb.—*Caphi* ; Guz. & Mar.—*Bund* ; Tam. & Tel.—*Capi* ; Pers.—*Cahwa* ; Arab.—*Kahwa, Bun.*

See page 68.

Colchicum luteum Baker. (see page 125).

Combretum pilosum Roxb.

VERN.—Hind.—*Bhoree loth, Thoonia loth.*

It is a shrub growing in the Cachar district, Assam. Decoction of the leaves is useful as anthelmintic.

Convolvulus scammonia.

VERN.—Hind., Sind., Arab. & Pers.—*Sák munia* ; Punj.—*Sakmunia.*

Scammony resin is obtained from the rhizomes of *C. Scammonia.* Most of the bazar stuff is imported into India from Syria and Asia minor and the Bombay drug dealers adulterate it with other inert substances. Scammony is a hydragogue cathartic and is largely administered in dropsy and anasarca.

Coptis teeta Wall. (see page 295).

Coriandrum sativum Linn.

VERN.—Sans.—*Dhányaka* ; Hind.—*Dhanya* ; Beng.—*Dhane* ; Bomb.—*Dhana* ; Tam.—*Kotamalli* ; Tel.—*Kotimiri* ; Arab.—*Kuzbarah* ; Pers.—*Kushniz* ; Burm.—*Nau-nau.*

The seeds are used as a condiment in every household. An infusion of the seeds is useful in flatulence, indigestion, vomiting and other intestinal disorders. In combination with cardamom and caraway it forms a good carminative mixture.

Cratæva religiosa Forst. and other species.

VERN.—Sans.—*Varuna* ; Hind.—*Barna* ; Beng.—*Barún* ; Punj.—*Barna* ; Bomb. & Mar.—*Kúmla* ; Tam.—*Maralingam* ; Tel.—*Uskia* ; Burm.—*Katat* ; Kan. & Mal.—*Nirválá, Vitusi.*

Two varieties of Cratæva are important from medicinal point of view, *C. nurvala* and *C. roxburghii.* A decoction prepared from 4 ounces of the bark of the former in 1½ pint of water is said to be a good antiperiodic and tonic in doses of about 2 ounces two or three times daily. This mixture is also said to be useful in cases of kidney and bladder stones. The leaves of *C. roxburghii* are very good counter-irritant and can be used as a substitute for mustard. For this purpose, a poultice made of the fresh leaves with lime water or warm water is employed.

Croton tiglium Linn.

VERN.—Sans.—*Jayapála* ; Beng.—*Jaypal* ; Hind.—*Jamál-gota* ; Tam.—*Nerválum* ; Tel.—*Nepála-vitua* ; Kan.—*Nepála* ; Mar.—*Jepál* ; Guz.—*Nepál* ; Burm.—*Kanako* ; Malay.—*Bori* ; Java.—*Cheraken* ; Pers.—*Dund* ; Arab.—*Batú, Dand.*

The croton seeds are oval shaped with a light coloured shell and a soft kernel inside. They are used as a drastic and violent purgative in conditions like apoplexy, insanity and convulsions attended with high blood pressure. The doses in such cases should never exceed 2 grs. mixed with honey. The expressed oil from the seed is given in doses of 1 minim only. The oil has been tried as counter irritant

and vesicant in rheumatism, synovitis, paralysis and painful affections of joints and limbs.

Cubeba officinalis Miq. (see page 227).

Cuminum cyminum Linn. (see page 82).

Cuprum sulphas.

VERN.—Sans.—*Túttha* ; Hind.—*Nilá-tútá* ; Beng.—*Tutia* ; Tam.—*Mayil-tuttam* ; Tel.—*Mayilu-tuttam* ; Malay.—*Túri* ; Guz.—*Mórtútá* ; Arab.—*Zájul-akhzar* ; Pers.—*Záke-sabz* ; Burm.—*Douthá*.

Copper sulphate occurs in blue crystalline masses. The stuff obtained from the bazar is usually impure. It may be purified by dissolving in water and re-crystallising. For internal administration, a special method of purification is recommended by the Hindu physicians. Bazar copper sulphate is rubbed with honey or ghee and then exposed to heat for some time. It is then soaked in water for three days and finally dried in the sun. In doses of $\frac{1}{4}$ to 2 grains it is said to be beneficial in chronic diarrhœa and dysentery. Large doses will act as emetic and are frequently used in opium, nux vomica and arsenic poisonings. In indolent ulcers and exuberant granulations, a weak lotion will be found effective. In epistaxis and other forms of bleeding from mucous surfaces, a lotion made by adding 4 grains of copper sulphate to an ounce of water is recommended.

Curculigo orchioides Gærtn.

VERN.—Sans.—*Mushali* ; Hind. & Bomb.—*Káli-músli* ; Beng.—*Tála mulí* ; Tam.—*Nilap-panaik-kizhangu* ; Tel.—*Néla tádi* ; C. P.—*Mussulkund* ; Sing.—*Hin-bin-tal*.

C. orchioides is the 'kala musli' of the bazar and has to be distinguished from the tuberous root of *Asparagus adscendens* which goes by the name of 'safed musli'. The root contains a good deal of mucilage and is used as a demulcent alterative and tonic during convalescence after acute illness. A palatable form of administration is to give about 1 to 2 ounces of the root in warm milk and sugar.

Curcuma aromatica Salisb.

VERN.—Sans.—*Vanaharidrá* ; Hind.—*Jangli-haldi* ; Beng.—*Banhalud* ; Bomb.—*Ambé-haldí* ; Tam.—*Kasturi-manjal* ; Tel.—*Kasturi pasupa* ; Guz.—*Kapur kachali* ; Kan.—*Kastúri-arishiná* ; Burm.—*Kiyása noin* ; Sing.—*Duda-kaha* ; Arab.—*Judwar*.

Uses similar to *C. longa*.

Curcuma longa Roxb.

VERN.—Sans.—*Haridra* ; Hind.—*Haldi* ; Beng.—*Halud* ; Punj.—*Halja* ; Tam.—*Manjal* ; Tel.—*Pasupu* ; Guz.—*Halada* ; Burm.—*Tanum* ; Arab.—*Kurkum* ; Pers.—*Zard-chóbah* ; Sing.—*Kahá*.

The dried rhizome is used medicinally and as a condiment. As a local application, in combination with lime it is valuable in sprains, bruises and inflammatory troubles of the joints. An ointment prepared from *C. longa*, mustard oil and hemp leaves is effective in eczema, itches, etc.

Cyperus rotundus Linn.

VERN.—Sans.—*Mustá* ; Beng.—*Muthá* ; Bomb.—*Mustá* ; Guz.—*Motha* ; Tam.—*Kórai* ; Tel.—*Gandala* ; Mar.—*Bimbal* ; Sing.—*Kalanduru*.

The rounded rhizome of the plant is found everywhere in India. The bulbous root is largely used by the Kavirajes, grounded with ginger and honey and given as astringent, stomachic and carminative in gastric and intestinal disorders. The Romans used it as emmenagogue in uterine complaints.

Dæmia extensa R. Br.

VERN.—Hind.—*Utran, Ságování* ; Beng.—*Chhágal-báti* ; Tam.—*Veli-parutti* ; Tel.—*Jittupaku* ; Mar.—*Utarani* ; Guz.—*Nágala-dudheli*.

This plant has been used extensively for its emetic and expectorant properties especially in the Bombay Presidency. Powdered leaves in doses of 5-10 grs. or a decoction of the leaves in 1-2 ounce doses are good expectorants. The juice of *Ocimum sanctum* and honey are sometimes added to the decoction to help the expectorant effects.

Datura (see page 127).

Dipterocarpus lævis Ham., **D. alatus** Roxb. and other species.

VERN.—Hind. & Bomb.—*Garjan-ka-tel* ; Tam.—*Yennai*.

Several species of Dipterocarpus plants grow in Chittagong, Burma and Siam. These plants yield an oleoresinous extract which is popularly known as 'gurjan balsam' or 'wood oil'. The 'gurjan oil', procurable in the Indian bazars, is chiefly the product of *D. lævis* and *D. alatus*. The oil has a pale grey or light brown colour and may be as thick as honey. It resembles copaiba balsam and has been used as a substitute for oil of copaiba in the treatment of gonorrhœa in doses of ½ to 1 teaspoonful in mucilage, milk or gruel, twice or thrice daily. At one time, the balsam was used both internally and externally in the treatment of leprosy but it has since been discontinued.

Eclipta alba Hassk.

VERN.—Sans.—*Kesarája* ; Hind.—*Mochkand, Bhangra, Babri* ; Beng.—*Kesuti, Keysuria, Keshuri* ; Bomb.—*Máká, Bhángra, Dodhak* ; Tam.—*Karisha-langanni, Kaikeshi* ; Tel.—*Galagara, Guntakalagara.*

The roots and the leaves of the plant are considered to be cholagogues and have been largely used alone or in combination with ajowan seeds in derangements of the liver and gall-bladder. They have also been used as substitutes for Taraxacum, a reputed and popular liver tonic.

Elettaria cardamomum Maton. (see page 136).

Embelia ribes Burm. and **E. robusta** Roxb.

VERN.—Sans.—*Vidanga* ; Hind.—*Baberáng, Wawrung* ; Beng.—*Bhiranga, Bhai-birrung* ; Punj.—*Babrung* ; Bomb.—*Kárkannie, Vaivarang, Vavadinga* ; Tam.—*Váyu-vilamgam, Vellal* ; Tel.—*Váyu-vilamgam* ; Pushtu—*Bábrang.*

The seeds of these plants are used as an anthelmintic. Powdered seeds in doses of one to two drachms are administered with sugar or honey in an empty stomach to expel tapeworms.

Enicostema littorale Blume.

VERN.—Hind.—*Chota-kirayata* ; Bomb.—*Manucha, Kadavinayi* ; Tam.—*Vallari* ; Tel.—*Nela-guli, Nela-gulimidi.*

It is known as 'chota chiretta' in some parts of India. The flowering plants are used as stomachic, carminative and bitter tonic and are commonly available in the Punjab and Bombay bazars.

Eugenia jambolana Lam.

VERN.—Sans.—*Jambu, Jambula* ; Hind.—*Jaman, Jám, Phalinda, Jamni phaláni, Pharenda, Paiman* ; Beng.—*Jam, Kála-jám* ; Bomb.—*Jambul, Jámbudo, Jambura, Jámbudi* ; Tam.—*Nával, Narvel, Nawar, Naga* ; Tel.—*Naredu, Rúcha-neredu, Pedda-neredu, Nairuri, Nareyr, Nasodu.*

The seeds are considered astringent in diarrhœa and dysentery preferably in combination with the seeds of *Mangifera indica* (Mango). Powdered seeds are said to diminish the quantity of sugar in urine in diabetes. A decoction of the bark has also been used in cases of dysentery in combination with cardamom and cinnamon.

Euphorbia neriifolia Linn.

VERN.—Sans.—*Snuhi, Vujri* ; Hind.—*Sehund, Thohar, Sij, Patton-ki-send* Beng.- *Mansa-sij, Páta-sij, Hij-daona* ; Bomb.—*Minguta,*

Mingut, Nivadunga, Thohur, Thor, Newarang ; Tam.—*Ilaik-kalli* ; Tel. —*Aku-jemudu* ; Burm.—*Shasaung, Shazávn-mina.*

This plant is found in the hilly regions of Central India and is also cultivated in Bengal. The fleshy cylindrical stems exudes when injured, a milky juice which is used to relieve earache. In combination with chebulic myrobalans and long peppers, the juice is also given as a drastic purgative in dropsy and general anasarca.

Euphorbia pilulifera Linn. (see page 318).

Ferri sulphas.

VERN.—Sans.—*Kasisa* ; Hind.—*Kasis, Hira kasis, Kahi* ; Beng.—*Hirákos, Hira-kosis* ; Bomb.—*Kashish, Hira-kashish* ; Tam. & Tel.—*Anna-bedi.*

Crude, greenish blue crystals of sulphate of iron are available in all the bazars in India. On account of its astringent properties, it is used as a lotion in erysipelas, anæmia and constitutional debility following on malaria, kala-azar, etc., the following prescription has been found useful:—ferri sulphas 4 grains, omum water 6 ounces, infusion chiretta 6 ounces. Two ounces of the mixture is given twice or thrice daily.

Ferula fœtida Regel. (see page 171).

Ficus bengalensis Linn.

VERN.—Sans.—Vata ; Hind.—*Bor, Bar, Bargat* ; Beng.—*Bat, Bar* ; Punj.—*Bera, Bor, Bohar, Bargad* ; Bomb.—*Wad, Barghat, Bur, Vada* ; Tam.—*Ala* ; Tel.—*Mari, Peddi mari* ; Pushtu—*Baagat, Bar.*

The banyan tree is planted throughout India. It grows to a height of about 100 feet and is a common roadside tree. The milky juice that exudes from the tree is a valuable astringent in sores and ulcers. Infusion of the young buds, owing to the large percentage of tannin it contains, is useful in diarrhœa and dysentery. An infusion of the bark is said to have specific properties of reducing the blood sugar in diabetes.

Ficus glomerata Roxb.

VERN.—Sans.—*Udumbara* ; Hind.—*Gúlar, Paroa, Lelka, Umar, Tue, Dimeri* ; Beng.—*Jagya-dumar, Yajnadumbar* ; Punj.—*Kathgúlar, Krumbal, Rumbal, Batbor, Palák, Kakammal, Dadhuri* ; Bomb.—*Umbar, Umbar gular, Atti, Rumadi* ; Tam.—*Atti* ; Tel.—*Moydi, Atti, Bodda, Paidi, Mari, Medi.*

It is a large tree found in Bengal, Central India, Assam, Burma, and the Deccan. The bark, leaves, fruits and the milky exudation have

all been employed in indigenous medicine. An infusion of the bark and the leaves is astringent and has been employed as mouth wash in spongy gum and also internally in dysentery, menorrhagia and hæmoptysis. The fruit is considered to be astringent and carminative. Both the fruit and the sap extracted from the trunk of the tree have been described as valuable medicine in diabetes.

Ficus religiosa Linn.

VERN.—Sans.—*Aswaththamu, Asvattha* ; Hind.—*Pipal* ; Beng.—*Ashathwa, Aswat, Asúd* ; Punj.—*Pipal, Bhor* ; Bomb.—*Pimpal, Piplo, Pipur, Pipul* ; Tam.—*Arasa, Aswartham* ; Tel.—*Rai, Raiga, Rávi, Kulla rávi.*

The 'peepul' tree grows wild in many parts of India and is also cultivated, as it is held sacred by the Hindus. An infusion of the bark is astringent and has been used in unhealthy ulcers and various skin diseases.

Fish liver oil.

VERN.—Hind.—*Mach-chi-ká-tél* ; Beng.—*Macher tel* ; Bomb.—*Masolicha-tela* ; Tam.—*Min-yenney* ; Tel.—*Chépa-núne.*

Extraction of oil from the fish is carried on in many places along the west coast of India. Fish oil is used as a cheap substitute for cod liver oil. Oil derived from the livers of fishes like hilsa, sharks, skates, sand fishes, etc., is beneficial in debilitating diseases and in malnutrition. One to two teaspoonful of fish oil, sweetened and flavoured, can be given once or twice daily in phthisis and rickets. Most of the fish oil available in the market, however, is not distilled from the livers only but is crudely manufactured from the whole fish. Such oil therefore has very little utility as a therapeutic agent and moreover turns rancid quickly on keeping.

Fœniculum vulgare Gærtn. (see page 172).

Fumaria officinalis Linn. and **F. parviflora** Lamk.

VERN.—Hind.—*Pitpapara, Pitpápra* ; Beng.—*Ban-sulpha* ; Bomb.—*Pitpápra, Shatra, Pitpapda* ; Tam.—*Turá* ; Tel.—*Cháta-ráshi* ; Arab.—*Bukslat-ul-mulik, Baglatul-mulk* ; Pers.—*Shatra, Shahtarah* ; Pushtu—*Sháhtara, Pitpapra, Pápra.*

F. officinalis is not indigenous to India but is imported into the country from Persia. An allied variety, *F. parviflora,* is found throughout the Indo-gangetic plain. An infusion prepared from the stem and the leaves is used in dosage of 1 to 2 ounces thrice daily as alterative, tonic, diuretic and diaphoretic.

Garcinia mangostana Linn.

VERN.—Hind.—*Mangústán ;* Beng.—*Mangustán ;* Bomb.—*Mangostin, Mangustan, Mangastin ;* Burm.—*Mengkop, Mimbu, Mengut, Youngzalai.*

Mangosteen fruit is chiefly imported into India from Singapore and the Strait Settlements, though to some extent it is cultivated in Burma and Madras Presidency. The decoction of the rind of the fruit is a domestic remedy for diarrhœa and dysentery.

Garcinia purpurea Roxb.

VERN.—Hind.—*Kokam, Kokam-ká-tél ;* Bomb.—*Kokam, Amsúl* (the fruit), *Kokam chatel, Ratambu-sála, Bhirand, Katambi, Bhirandel ;* Tam.—*Múrgalmara.*

The oil expressed from seeds is known as 'Kokum' butter. Owing to its emollient and soothing properties, it is considered an excellent substitute for animal fat as a basis for ointment.

Gentiana kurroo Royle. and other species (see page 177).

Ghee.

VERN.—Sans.—*Ghrita, Ghrittham ;* Hind.—*Ghi ;* Beng.—*Ghee, Ghrita ;* Tam. & Tel.—*Neyi.*

Ghee is chiefly prepared from the milk of cows and buffalows. It is an esteemed article of diet and its local application over blisters and inflammatory swellings is much in vogue. Old ghee is very useful as a local application in pleurisy and painful affections of joints.

Gloriosa superba Linn.

VERN.—Sans.—*Lángaliká, Agnisikhá, Kalikari ;* Hind.—*Kariári, Karihári, Languli ;* Beng.—*Bishalánguli, Ulatchandal, Bisha ;* Punj.—*Mulim, Kariári ;* Bomb.—*Karianag, Nágkaria, Indai ;* Tam.—*Kalaip-paik-kishangu, Kárttikaik-kishangu ;* Tel.—*Agni-shikha, Kalappa-gadda, Adavi nábhi, Potti dumpa.*

It is common in the forests of Bengal, Burma and Ceylon. The tubers are flattened or cylindrical in shape and very bitter to the taste. Its use as an abortifacient has been mentioned by the old sanskrit writers. Contrary to the popular belief, the root is not poisonous in ordinary doses. On the other hand, it seems to possess alterative and tonic properties. A paste formed with water is an useful anodyne application in bites of poisonous insects and reptiles.

Glycyrrhiza glabra Linn. (see page 180).

Gmelina arborea Linn.

VERN.—Sans.—*Gumbhari, Sripnari* ; Hind.—*Kumbhár, Gumbhár, Kambhar* ; Beng.—*Gamari, Gúmár, Gúmbár* ; Bomb.—*Shewun* ; Punj.—*Kúmhár, Gúmhár* ; Tam.—*Gumudu téku, Gumadi* ; Tel.—*Gúmar-tek, Pedda gomru* ; Santh.—*Kasmár* ; Burm.—*Yamanai.*

The root, fruit, bark and leaves of this plant have all been used in medicine, but the root and the fruit are to be preferred. An extract of the root is bitter and tonic and has been administered in various ailments. Combined with liquorice, honey and sugar, it is considered to be galactagogue.

Gymnema sylvestre Br. (see page 319).

Gynocardia odorata R. Br. (see page 393).

Hedychium spicatum Ham.

VERN.—Sans.—*Kapurakáchalí* ; Hind.—*Sit-rutí, Kapúr kachri* ; Bomb.—*Sír, Sutti* ; Mar.—*Kapur krachari* ; Punj.—*Khor, Kachur-kachu, Ban kela, Shedúri,* (Bazár root) = *Kapúr kachrí* ; Tam.—*Shimai-kich-chilik kishangu.*

The plant grows abundantly in the Punjab and Nepal. The root-stock that is found in the bazar is reddish brown in colour with a pungent bitter taste. It is the common ingredient of 'abir' that is used in India during the 'holi' festival. Medicinally the root stock is employed as a stomachic, carminative and bitter tonic.

Hedyotis auricularia Linn. (see page 323).

Helicteres isora Linn. (see page 324).

Hemidesmus indicus R. Br. (see page 182).

Herpestis monniera H. B. K. (see page 325).

Hibiscus abelmoschus Linn.

VERN.—Sans.—*Zatákasturiká, Lata-kasturíkam* ; Hind.—*Mushk-dana* ; Beng.—*Mushak-dana* ; Bomb.—*Mishk-dána, Mushk-bhendi-ke-bij* ; Tam.—*Kasturi-vendaik-kay-virai* ; Tel.—*Kastúri-benda vittulu* ; Pers.—*Mushk-dana* ; Arab.—*Habbul-mishk.*

The musk-mallow, so-called because the seeds possess an aromatic odour resembling that of musk, is common throughout the hotter parts of India. Dr. Mohideen Sheriff speaks highly of the tincture prepared from the seeds as stimulant, carminative and antispasmodic and recommends it in hysteria, debility and nervousness.

Hydrocotyle asiatica Linn.

VERN.—Sans.—*Mandukaparní, Cheka-parní*; Hind.—*Bráhmamanduki, Khulakhudi*; Beng.—*Thol-kuri, Bráhmamandukí*; Bomb.—*Karivana, Karinga*; Tam.—*Vallá-rai, Babassa*; Tel.—*Mandúka-bramhakúráku*; Arab.—*Artániyál-hindi.*

H. asiatica is a weed common in all parts of India. For a long time it has been used by the Indian physicians as a remedy for various skin diseases. The leaves are only recognised in the Pharmacopœia Indica, but many investigators have advocated the use of the entire plant, root, twigs, leaves and seeds in medicine, especially the first named which contains the major portion of the active volatile principle 'vellarin'. The leaves are dried in the shade so that no active principle is lost, powdered and kept in well stoppered bottle. This powder is used as a remedy for eczema, leprosy, secondary syphilitic ulcers either as an ointment with vaseline or as a dusting powder. Internally, it has been used as an alterative and tonic and can be administered in the powdered form in 5-10 grains doses three times daily. A decoction of the entire plant one ounce in a pint, boiled for about 15 minutes, is an elegant preparation in doses of 1 to 2 ounces.

Hygrophila spinosa T. And.

VERN.—Sans.—*Ikshugandhá, Kokiláksha*; Hind.—*Tálmakhána, Gokhula kanta, Gókshura*; Beng.—*Kuliákhárá, Kantakalika*; Bomb.—*Tálimkhana, Kolsunda*; Mar.—*Tálimakhána*; Tam.—*Nirmalli*; Tel.—*Nirguvi veru*; Santal—*Gokhula janum.*

This spiny bush is common throughout India. The whole plant has been used medicinally, specially the root and the leaves. A decoction of the root is useful in hepatic derangement and genito-urinary disease as a diuretic. About 2 ounces of the root is boiled in a pint of water for 20 minutes to half an hour in a closed vessel. Dose of the preparation should be 1 to 2 ounces two or three times daily. All parts of the plant have similar medicinal properties and can be bought almost in every important bazar of India.

Hyoscyamus niger Linn. (see page 183).

Ipomæa digitata Linn.

VERN.—Sans.—*Vidári, Bhumikashmánda*; Hind.—*Biláí kand*; Beng. *Bilai-kand, Bhúi-kumrá*; Bomb.—*Bhui-kohala*; Tel.—*Matta-pal-tiga.*

The large tuberous roots of this plant are used as tonic, alterative and aphrodisiac. It is mucilaginous and has a bitter taste. In Bombay and the Punjab, these roots are sold as 'gand' and are much in demand.

Ipomæa turpethum Br. and **I. hederacea** Jacq. (see page 185).

Iris ensata Thunb.

VERN.—Hind. & Bomb.—*Keore-ká-múl ;* Pers.—*Bíkh-i-banafshah ;* Arab.—*Irsá.*

I. florentina Linn.

VERN.—Hind.—*Irsa, Sosun ;* Punj.—*Irisa ;* Kash.—*Bekh sosan ;* Pers.—*Bekh-i-banfsa.*

Orris root that is obtained in the Bombay market is mainly derived from *I. germanica* which grows in Kashmir. Some part is also imported into India from Persia. There is practically no mention of the medicinal use of this plant by the Hindu physicians. The Mohammedan physicians use the root as aperient and diuretic and in liver complaints.

Jatropha curcas Linn.

VERN.—Sans.—*Kanana eranda, Puravata-yeranda ;* Hind.—*Bagberenda, Safedind, Bhernda, Jangli-arandi ;* Beng.—*Bágbherendá, Bonbhérandá, Erandá-gáchh ;* Bomb.—*Mogalíeranda ;* Punj.—*Rattanjot, Japhrota ;* Tam.—*Kattámanakku ;* Tel.—*Népálam ;* Arab. & Pers.—*Dande-nahrí.*

It is a common plant growing in waste places. The oil from the seed is pale yellow and acts as a purgative like castor oil. The seeds have also been used as a drastic purgative but are likely to give rise to toxic symptoms. The viscid juice is a hæmostatic and is used in ordinary cuts and bruises. Decoction of the leaves is also used for similar purposes and as a gargle to strengthen the gums.

Lallemantia royleana Benth.

VERN.—Hind. & Punj.—(Seeds) *Gharei kashmálú ;* Bomb. & Pers.—*Tukhm-i-bálangú* (seeds).

The seeds known as 'tokmalanga' resemble 'isphagul' but are of a black colour. It is given internally as a diuretic and soothing drink in urinary troubles. Locally they are applied on boils and abscesses.

Lawsonia alba Lam.

VERN.—Sans.—*Mendhi, Kuravaka ;* Hind.—*Mehndi ;* Beng.—*Mendi, Shudí ;* Punj.—*Mehndí, Panwár ;* Mar.—*Méndí ;* Tam.—*Marithondi ;* Tel.—*Góranta.*

The leaves of the plant are used to stain the finger nails. It has been used in enlargement of spleen, jaundice and leprosy.

Linum usitatissimum Linn.

VERN.—Sans.—*Uma ;* Hind.—*Alsí, Tísí ;* Beng.—*Tísí ;* Bomb.—*Aldsí, Javas ;* Punj.—*Alísh, Tísí ;* Tam.—*Alshi-virai ;* Tel.—*Atasi ;* Pers.—*Zaghú.*

Linseed is a well-known substance throughout India. As an external application linseed poultice is useful in abscesses, boils, bronchitis and quinsy. Linseed oil, though rarely used internally, is a common basis for embrocation and liniment. Linseed tea prepared by adding an ounce of the seed in 1 pint of water, boiled for 10 minutes and strained is a useful drink in diarrhœa dysentery and urinary complaints.

Litsæa sebifera Pers.

VERN.—Hind.—*Garbijaur, Ménda* ; Beng.—*Kúkúrchita, Ratún, Garur* ; Bomb.—bark=*Maida-lakrí,* leaves=*Chickana* ; Punj.—*Medasak, Chandna* ; Tam.—bark=*Maida-laktí* ; Tel.—*Narra alagi, Meda.*

The bark of *L. sebifera* is one of the best known bazar drugs and goes by the name of 'maida-lakin.' It contains a good deal of mucilage and has been used as demulcent and astringent in diarrhœa and dysentery. *Freshly ground bark is a local* hæmostatic.

Luffa acutangula Roxb.

VERN.—Sans.—*Jhingáka* ; Hind.—*Jinga, Torai* ; Beng.—*Jhingá, Jínga* ; Bomb.—*Jinga, Turaí* ; Punj.—*Jhinga, Kálí torí, Turáí* ; Tam.—*Píkunkai* ; Tel.—*Burkai, Bira-káya,* Pers.—*Khiyár.*

The fruit juice, seeds and leaves of the plant are bitter and are used medicinally. The seeds are considered to be emetic and in smaller doses 5-10 grs. act as an expectorant. They have been highly spoken of by Dr. Mohideen Sheriff as a valuable substitute for ipecacuanha in dysentery. An emulsion of the kernel of the seed in water is a good form of administration. Another variety of luffa, known as *L. echinata* is a common drug in the Bombay bazar and is brought from Guzrat. The fruit is given in the form of an infusion or decoction in jaundice and biliary and intestinal colic.

Mallotus philippinensis Muell. Arg. (see page 338).

Mel.

VERN.—Sans. & Beng.—*Madhu* ; Hind. & Bomb.—*Madha* ; Tam.—*Taen* ; Tel.—*Taenu* ; Punj.—*Saht* ; Kash.—*Mhach* ; Malay—*Ayur-mader* ; Sing.—*Mipanny* ; Burma—*Pya-ya.*

Although it has no marked medicinal properties, honey is extensively used in every household of India. The honey that is sold in the bazar is derived from the honeycomb of several species of wild bees. Chemically, honey is mainly a mixture of dextrose and levulose. It is a pleasant vehicle for adminstering bitter mixures for cough and fever especially in children.

Melaleuca leucadendron Linn.

VERN.—Hind.—*Kayaputi* ; Beng.—*Cajuputte* ; Bomb.—*Káyákuti* ; Mar.—*Cajupútá* ; Tam.—*Kayapute, Kijápúte* ; Malay.—*Cajuputi, Káyá pútia.*

The plant is a native of Tennaserim, Malay islands and Australia. The leaves yield on distillation, a thin, greenish essential oil known as Cajupput oil. A large quantity of the oil is imported into Singapore from Java, Manilla and Celebes and other places and thence to Calcutta and Bombay. Cajuput oil is a favourte remedy in inflamed and painful joints. The oil when taken internally is said to be useful in cholera and diarrhœa but is apt to produce inflammation of the kindney.

Mentha arvensis Linn. (see page 188).

Mimusops elengi Linn.

VERN.—Sans., Hind. & Beng.—*Bakul* ; Bomb.—*Borsali* ; Punj.—*Maulsari* ; Tam.—*Mogadam* ; Tel.—*Pogada* ; Malay—*Elengi* ; U. P.—*Maulsári* ; Uriya—*Baulo* ; C. P.—*Ghólsari* ; Guz.—*Bolsari* ; Burm.—*Khaya* ; Sing.—*Múnemal.*

This tree is largely cultivated in the Deccan and other parts of India. The astringent property of the bark has long been recognised and a decoction prepared from it is used as gargle. The seeds are purgative and are sometimes effective as a suppository in children. A fatty oil distilled from the seeds is available in Tanjore.

Moringa pterygosperma Gærtn. (see page 344).

Moschus moschiferus Linn. (see page 422).

Musa sapientum Linn.

VERN.—Sans.—*Kadali, Rambha* ; Hind., Bomb., Punj. & Guz.—*Kéla* ; Beng.—*Kala* ; Tam.—*Vazhaip pazham* ; Tel.—*Ariti, Kadali* ; Sind.—*Kewiro* ; Malay—*Vasha* ; Sing.—*Kadali, Rambha* , Burm.—*Ya-thi-lan* ; Pers. & Arab.—*Mouz.*

The banana tree is common throughout India. The green tender leaves form an excellent cover for denuded surfaces and are extensively used in indigenous surgical practice. The ripe fruit is emollient and demulcent and is rich in vitamin content.

Mylabris chichorii Fabr. (see page 193).

Myrica nagi Thunb.

VERN.—Sans.—*Katphala* ; Hind., Beng., Bomb. & Sind.—*Káiphal, Káyaphul* ; Punj.—*Kaphal, Kaiphal* ; Tam.—*Marudampattai* ; Tel.—

Kaidaryamu ; Malay—*Marutamtoli* ; Nepal—*Kobusi* ; Guz.—*Kariphal* ; Arab.—*Azuri* ; Pers.—*Dárshishaán.*

The plant is found chiefly in the North Western Frontier Provinces and the Simla district. The decoction of the bark mixed with ginger and cinnamon is a favourite remedy in chronic bronchitis, asthma and catarrhal conditions of the lungs. It is also given in diarrhœa and dysentery as an astringent.

Myristica officinalis Linn. (see M fragrans, page 195).

Myrsine africana Linn.

VERN.—Hind.—*Chapra* ; U. P.—*Chápra* ; Punj.—*Bebrang* ; Arab.—*Baibarang.*

This green shrub is found in the Himalayas from Kashmir to Nepal. The fruits are used medicinally for their anthelmintic and cathartic properties.

Nardostachys jatamansi DC.

VERN.—Sans., Hind. & Beng.—*Jatámánsi* ; Bomb.—*Balacharea* ; Tam.—*Jatamáshi* ; Tel.—*Jatámámshi* ; Guz.—*Jatamasi* , Kan.—*Jetamávashi* ; Malay—*Jeta-mánchi* ; Sing.—*Jura mánsi* ; Arab.—*Sumbulu'l-hind* ; Pers.—*Sunbuluttib.*

The roots met with in the bazar are really the under-ground stems, having the thickness of a goose quill. They possess an aromatic odour and a somewhat bitter taste and should always be used fresh. The infusion prepared from the roots has a great reputation in spasmodic attacks of hysteria, palpitation of heart and chorea. in doses of 1—2 ounces three times daily. The powdered root is given in doses of 10—20 grains.

Naregamia alata W. & A.

VERN.—Bomb.—*Pittpápra* ; Kan.—*Nepa-naringu* ; Malay—*Nela-naregan* ; Goa—*Trifolio.*

This is known as 'Goanese Ipecacuanha' and is found in Western and Southern India. Decoction of the stem and leaves has been used in dysentery with successful result and is said to be as effective as ipecacuanha. The root has a pungent aromatic odour and is emetic and expectorant ; it is useful in chronic bronchitis and helps to expel mucus.

Nelumbium speciosum Willd.

VERN.—Sans. & Bomb.—*Kamala* ; Hind.—*Kanwal* ; Beng.—*Padma* ; Tam.—*Ambal* ; Tel.—*Erra-támara-veru* ; Uriya—*Padam* ; Punj.— *Kánwal* ; Sind.—*Pabban* ; Malay—*Tamara* ; Arab. & Pers.—*Nilufer.*

The lotus is an aquatic herb found everywhere in India. The root, flowers, stalk and leaves in the form of infusion are used in fever as refrigerant and diuretic.

Nicotiana tabacum Linn.

VERN.—Hind.—*Tamáku* ; Beng.—*Tamák* ; Bomb.—*Tambakhu* ; Tam.—*Pugai-ilai* ; Tel.—*Pogáku* ; Kan.—*Hoge sappu* ; Malay—*Puka yila* ; Burm.—*Sacpin* ; Sing.—*Dunga zha* ; Arab.—*Tanbák* ; Pers.—*Tanbáku.*

Tobacco plant is cultivated in Bengal, Burma, Madras and other parts of India. *N.rustica*, the Turkish tobacco is also cultivated in some parts of Northern India. Tobacco leaves can be bought in every bazar of India and are used in various ways, *e.g.* they are smoked, chewed with pan, or are mixed with molasses to from 'tamak'. Owing to the presence of nicotine and nicotianine, excessive tobacco smoking gives rise to chronic inflammation of the bronchial mucous membrane, nervous depression and sleeplessness. Decoction of the leaves is a useful external application in inflammatory swellings and tobacco leaves have been used in orchitis. For spongy gums and toothache, chewing of tobacco leaf is a favourite remedy in India.

Nigella sativa Linn.

VERN.—Sans.—*Krishna-jiraka* ; Hind. & Beng.—*Kála jira* ; Bomb.—*Kálenjire* ; Tam.—*Karun-shirogam* ; Tel.—*Nalla-jilakra* ; Kan.—*Kari-jirigi* ; Kash.—*Túkm-i-gandna* ; Afg.—*Siyah-dáru* ; Burm.—*Samon-né* ; Sing.—*Kaluduru* ; Arab.—*Sh-ouniz* ; Pers.—*Siyáh-dánah.*

The seeds possess well-marked carminative and stomachic properties and are used in combination with other aromatic substances and bitters. A favourite external application used in eczema and pityriasis is composed of bruised seeds 2 ounces, *Psoralia corylifolia* seeds 2 ounces, bdellium 2 ounces, coscini radix 2 ounces, sulphur 1 ounce and cocoanut oil 2 pints.

Ocimum basilicum Linn.

VERN.—Sans.—*Munjariki* ; Hind.—*Sabzah, Babui-tulsi* ; Beng.—*Babui tulsi* ; Punj.—*Baburi* ; Mar.—*Sabza* ; Tam.—*Tirnut-patchi* ; Tel. —*Bhú-tulasi* ; Malay—*Tiru nitru* ; Uriya—*Dhála tulasi* ; Santal—*Bhar-bari* ; Sind.—*Sabajhi* ; Arab.—*Sháhasfaram* ; Pers.—*Firanj-mushk.*

This herb is common throughout India. The seeds contain a large amount of mucilage and are demulcent and diuretic. A teaspoonful of the seeds in a glass of water with some sugar forms an excellent drink useful in gonorrhœa and cystitis.

Ocimum sanctum Linn.

VERN.—Sans., Tam. & Tel.—*Tulashi* ; Hind., Beng., Punj. & Bomb. —*Tulsi* ; Guz.—*Talasi* ; Kan.—*Tulashi-gidá* ; Malay—*Krishna-tulsi* ; Mar.—*Tulasa* ; Burm.—*Lun* ; Sing.—*Muduru-tulla.*

The sacred 'tulsi' plant is met with in many Hindu houses. The leaves are expectorant in chronic cough especially in children and are given sweetened with honey.

Oldenlandia biflora Roxb.

VERN.—Sans. & Beng.—*Khetpapra* ; Hind.—*Daman-papar* ; Tel.—*Verri néla vému* ; Goa—*Kazuri* ; Nepal—*Piriengo* ; Sing.—*Wal-pat-paadagam.*

It is a common plant of India. A decoction of the whole plant, the root, the stem and the leaf is used in liver complaints. In chronic malaria, the decoction is said to be a good febrifuge.

Onosma bracteatum Wall.

VERN.—Hind., Beng. & Tam.—*Gao-zabán.*

This is the 'gaozaban' that is obtained in most of the bazars of India. The leaves and flowers that are sold in the market are heavily adulterated with other varieties. Though much applauded by the indigenous practitioners as a tonic and an alternative, according to O'Shaughnessy the usefulness of the drug has been overrated. One ounce of 'gaozaban' in a pint of water, boiled for some time forms a useful diuretic and demulcent mixture and alleviates thrist and restlessness during fever.

Ophelia chirata DC. (see Swertia chirata, page 251).

Orchis latifolia Linn., **O. mascula** Linn. and other species.

VERN.—Hind., Pers. & Afg.—*Salap, Salab.*

The tuberous roots of these orchids and allied species are sold in the market under the name of 'salep misri'. These roots, finely powdered and boiled with milk, form a nutritious article of diet and are given in phthisis, diabetes, chronic diarrhœa and dysentery.

Oroxylum indicum Vent.

VERN.—Sans.—*Syonáka* ; Hind.—*Sauma, Arlú* ; Beng.—*Sona* ; Punj. —*Tátpalang* ; Bomb.—*Sauna-assar, Tetu* ; Tam.—*Vanga, Pana* ; Tel.—*Pampana* ; Uriya—*Pomponia* ; Santal—*Bana halak* ; Assam—*Kering* ; Nepal—*Totilla* ; C. P.—*Tattunia* ; Burm.—*Kyoung-sha* ; Sing.—*Totilla.*

This tree is common throughout India. The root bark is a common medicine of the Hindu materia medica and forms

one of the ingredients of 'dasamula,' (the compound decoction of ten roots) a favourite remedy in diarrhœa and dysentery. In otorrhœa, an oily preparation of the root bark with seasamum oil is recommended by Dr. U. C. Datta. The powdered bark in 5-15 gr. doses or as an infusion, has been recommended in rheumatic affections.

Oxalis corniculata Linn.

VERN.—Sans.—*Amlika, Chukrika* ; Hind. & Beng.—*Amrul* ; Bomb.—*Ambuti* ; Tam.—*Paliakiri* ; Tel.—*Pallachinla, Anboti-kura* ; Punj.—*Chukha, Amrul* ; Santal—*Tandi chato-marak* ; Assam—*Chengeri tenga* ; U. P.—*Ambuti* ; Malay—*Poliyárala* ; Arab.—*Hemda.*

The leaves of the plant have been used in fever, dysentery and scurvy. In desentery, the fresh juice of the leaves mixed with honey or sugar is said to be useful. In the Punjab and North-West Frontier Provinces, the juice of the whole plant along with onion is applied to remove warts.

Pæderia fœtida Linn.

VERN.—Sans.—*Prasárani* ; Hind.—*Gandhali, So maraji* ; Beng.—*Gandha bhádulia* ; Assam.—*Bedoli sutta* ; Nepal.—*Pade biri* ; Bomb.—*Prasáram* ; Mar.—*Hiranvel* ; Guz.—*Gandhana* ; Tel.—*Savirela.*

It is a common climber found in the Himalayas and also in Bengal and Assam. A soup prepared from the leaves is considered a good remedy for diarrhœa and dysentery and in fact, is given as a household remedy during convalescence from acute illness. The entire plant has been used externally for application on rheumatic joints.

Papaver somniferum Linn. (see page 196).

Pavonia odorata Willd.

VERN.—Sans.—*Bálá, Hrivera* ; Beng. & Hind.—*Bálá* ; Bomb.—*Bálá* ; Mar.—*Kálá-válá* ; Tam.—*Paramutty, Perámútiver* ; Tel.—*Erra-kúti* ; Kan.—*Bálarakkasi-gida.*

The root possesses an aromatic odour and mention is made of it in the Hindu medicine. Preparation of the root with 'bel' fruit (*Ægle marmelos*) is considered useful in dysentery.

Pedalium murex Linn.

VERN.—Hind.—*Farid-búti, Bará-gókhru* ; Beng.—*Bara-ghókru* ; Uriya.—*Gokshurá* ; Punj.—*Gokrú kalán* ; Mar.—*Mothe-gokharu* ; Guz.—*Mothan gokharu* ; Tam.—*Peru-nerunji* ; Tel.—*Pedda-palléru* ; Kan.—*Anne-galu-gidá* ; Malay.—*Káthe-nerinnil* ; Burm.—*Sule-gi* ; Sing.—*Ati-neranchi* ; Arab.—*Khasake-kabir* ; Pers.—*Khasake-kalán.*

The plant grows abundantly on the sea coast of Southern India and Ceylon. The yellow flowers when bruised emit a musk-like odour. The leaves when soaked in water will render the whole fluid mucilaginous and for this property, it has been advocated in gonorrhœa. An extract of the fresh leaves and stem in cold water is an efficient diuretic. About half a pint of the infusion taken daily is said to alleviate the burning sensation during micturition in gonorrhœa. It has also been tried in nocturnal emissions and impotency.

Peganum harmala Linn. (see page 347).

Peucedanum graveolens Benth. (see page 218).

Phyllanthus emblica Linn.

VERN.—Sans.—*Amálaki, Dhátri* ; Hind.—*Amla, Aura* ; Beng.—*Amlá, Amlaki* ; Uriya.—*Amlaki* ; Santal.—*Meral* ; Assam.—*Amluki* ; Nepal.—*Amla* ; U. P.—*Amla, Asula* ; Punj.—*Ambal, Amla* ; Bomb.—*Avalkati, Amla* ; Guz.—*Amla* ; Tam.—*Nelli-kái* ; Tel.—*Usri, Nelli* ; Burm.—*Shabju* ; Arab.—*Amlaj* ; Pers.—*Amuleh.*

The embelic myrobalan, the fruit of *P. emblica* is a common medicine used everyday in Indian households. The fruit has got a sour, astringent taste and is diuretic and laxative. A decoction prepared from the fruit combined with *T. chebula* and *T. belerica* is useful in chronic dysentery and biliousness, in doses of one ounce once or twice daily.

Picrasma quassioides Benn. (see page 220).

Picrorhiza kurrooa Benth. (see page 177).

Pimpinella anisum Linn. (see page 221).

Pinus longifolia Roxb. and other species (see page 223).

Piper betle Linn. (see page 349).

Piper cubeba Linn. (see page 227).

Piper longum Linn.

VERN.—Sans.—*Pippali* ; Hind.—*Pipal* ; Santal—*Ralli* ; Beng.—*Pipul* ; Nepal—*Pipla mol* ; Punj.—*Pipal, Darfilfil* ; Bomb.—*Pipli* ; Mar.—*Pimpli* ; Guz.—*Pipli* ; Tam. & Tel.—*Pipili* ; Kan.—*Yippali* ; Malay.—*Lada, Mulagu* ; Burm.—*Peikchin* ; Sing.—*Tippili* ; Arab.—*Dár-filfil* ; Pers.—*Filfildray, Pipal.*

Long pepper is cultivated extensively in Bengal, Assam and Madras Presidencies. Bengal exports large quantities to Bombay and other parts in Northern India. Both the Hindu and Mohammedan physicians have used an infusion made from it as carminative, stimulant and alterative. It is a stimulant expectorant and can be administered in asthma and chronic bronchitis sweetened with sugar or honey. Pepper is largely consumed as an article of spice.

Piper nigrum Linn.

VERN.—Sans.—*Maricha, Hapushá* ; Hind.—*Gúlmirch* ; Beng.—*Gólmorich* ; Kash.—*Martz* ; Punj.—*Gol-mirich* ; Guz. & Bomb.—*Miri, Kalamiri* ; Tam.—*Milágu* ; Tel.—*Miryála tige* ; Kan.—*Mirialu* ; Burm.—*Sa yo mai* ; Afg.—*March* ; Arab.—*Filfiluswud* ; Pers.—*Pilpil.*

Black pepper forms one of the important articles of trade. It is cultivated along the western coast of India and that growing in the Malabar Coast is considered to be the best. Black pepper is stimulant and carminative and has been prescribed in cholera, dyspepsia, flatulence, diarrhœa and various gastric ailments. The following combination is used in the treatment of cholera:—black pepper 20 grs., asafœtida 20 grs., opium 20 grs. made into 12 pills; one pill to be given every hour or every 2 hours. Locally, black pepper with ghee is believed to be a useful application for boils, urticaria and other skin diseases.

Pistacia integerrima Stewart. (see page 352).

Plantago ovata Forsk. (see page 354).

Plumbago rosea Linn. (see page 364).

Podophyllum emodi Wall. (see page 228).

Pongamia glabra Vent. (see page 366).

Potassii nitras.

VERN.—Sans.—*Yava-kshra* ; Hind. & Guz.—*Shora* ; Beng.—*Sórá* ; Beng.—*Sórá* ; Mar.—*Shóra-mitha* ; Tam.—*Potti-luppu* ; Tel.—*Petluppu* ; Malay—*Veti-uppa* ; Burm.—*Yán-zin* ; Sing.—*Pot-lunu* ; Arab.—*Ubkir* ; Pers.—*Shora.*

The nitre obtained in the bazars is generally impure. For medicinal use, it is dissolved in water, strained and recrystallised. Potassium nitrate is a good diuretic and is useful in fevers, influenza, measles, smallpox, etc. Inhalation of burning nitre gives great relief in asthma and spasmodic cough.

Premna integrifolia Linn.

VERN.—Sans.—*Ganikárikà* ; Hind.—*Arni, Agetha* ; Beng.—*Ganiári* ; Uriya.—*Aguyábát* ; Nepal.—*Gineri* ; Garhwal—*Bakorcha* ; Bomb.—*Arni* ; Mar.—*Chámári* ; Tam.—*Munnay* ; Tel.—*Ghebu-nelli* ; Malay—*Appel* ; Burm.—*Toung-than-gyee* ; Sing.—*Karnika.*

It is a common shrub met with in many parts of India especially along the sea coast. The root and the leaves have been mentioned by the old physicians as therapeutically active. A decoction of the root (about 4 ounces in a pint of water and boiled for 15 minutes) is given in doses of 2 to 4 ounces twice daily as a stomachic and a bitter tonic. The leaves have also been used for the same purpose.

Psidium guyava Linn.

VERN.—Sans.—*Amruta-phalam* ; Hind.—*Amrút* ; Beng.—*Peyara* ; Assam.—*Madhu riam* ; Nepal.—*Amuk* ; Punj.—*Amrút* ; Bomb.—*Perala* ; Mar.—*Jámba* ; Tam.—*Segapu, Koaya* ; Tel.—*Jama* ; Kan.—*Sebe* ; Burm.—*Mâlakâtbeng* ; Arab.—*Amrúd* ; Pers.—*Amrûd.*

Guava tree is found throughout India and the fruit is largely eaten. The root, the stem bark and the leaves contain a large percentage of tannic acid. Decoction of the leaves make a cheap and efficacious gargle for swollen gums and ulceration of the mouth. The root bark is an excellent astringent; 2 ounces of the bark in a pint of water boiled down to ½ pint makes an efficient mixture in infantile diarrhœa in doses of 1 to 2 teaspoonfuls two or three times daily.

Psoralea corylifolia Linn. (see page 367).

Punica granatum Linn.

VERN.—Sans.—*Dadima* ; Hind.—*Dhalim* ; Beng.—*Dalim* ; Punj.—*Dârú, Jaman* ; Bomb.—*Anara, Dalimba* ; Tam.—*Madalam* ; Tel.—*Dálimba* ; Burm.—*Salé-bin* ; Arab.—*Shajratur rummán* ; Pers.—*Darakhte-nár.*

The pomegranate is a much prized fruit and its medicinal virtues have been known for a long time. The rind of the fruit, the root bark and the juice of the fresh fruit have been used medicinally. It has been hailed as almost a specific for tapeworm infection. A convenient form of giving it without irritating the stomach is as follows:—fresh bark 2 oz, water 2 pints, boiled down to 1 pint and strained. Two ounces of the mixture is taken in an empty stomach in the morning repeated every half hour till 4 doses are given. The bowel should be later emptied by a dose of castor oil. The remedy is said to expel the head of the worms. The astringent property of the bark and rind of the fruit has been made use of in the treatment of chronic diarrhœa and dysentery.

Quercus infectoria Oliv.

VERN.—Sans.—*Majuphul*; Hind.—*Majuphul*, *Mazu*; Beng.—*Máju-phal*; Bomb.—*Maiphal*; Tam.—*Machakai*; Malay—*Majakani*; Burm.—*Pyintagar-ne-thi*; Arab.—*Uffes*; Pers.—*Mazú*.

The commercial galls used in medicine and dyeing are derived from this plant. It is not indigenous to India but grows in Greece, Asia Minor, Syria and Persia and is imported into India. In medicine the galls are largely used as astringent and styptic. For external application an ointment with vaseline is used; combined with opium they are useful in anal fissures and ulcerating hæmorroids. They have also been used in diarrhœa and dysentery and as gargle in stomatitis.

Rheum emodi Wall. and other species. (see page 235).

Ricinus communis Linn. (see page 237).

Rosa damascena Mill. (see page 239).

Salix caprea Linn.

VERN.—Hind. & Punj.—*Bed-mushk*; Pushtu—*Khwagawala*; Arab.—*Khiláf*; Pers.—*Bede-mushk*.

It is grown in the Punjab and Kashmir. All parts of the plant are available in the bazars of North-Western India. Decoction of the leaves is considered to be a febrifuge and the bark and stem have been used as astringent application in piles. An oil distilled from the leaves is used for making perfumed waters and as a tonic and aphrodisiac.

Salvia ægyptiaca Linn.

VERN.—Punj.—*Tukhm malanga*.

S. plebeia R. Br.

VERN.—Beng.—*Bhui-tulsi*; Punj.—*Sathi*; Sind.—*Kinro*; Bomb.—*Kammar-kas* (seeds).

***S. spinosa*.**

VERN.—Punj.—*Kanocha*.

The triangular seeds of this plant are available in the Punjab bazars. When soaked in water, they form a thick mucilaginous drink much used in gonorrhœa and urethritis.

Santalum album Linn. (see page 241).

Saraca indica (see page 376).

Saussurea lappa Clarke. (see page 377).

Scilla indica Baker. (see page 252).

Scindapsus officinalis Schott.

VERN.—Sans.—*Gaja-pippalí, Kari-pippalí* ; Hind.—*Gajapipal, Maidah, Barí-piplí* : Beng.—*Gajapipal, Gaj-pipul* ; Bomb.—*Thora-pimpli* ; Tam.—*Atti-tippili* ; Tel.—*Enuga-pippalu, Gaja-pippallu* ; Santal—*Dare jhapak*.

It is a climbing plant growing throughout the plains of India. The sliced and dried fruit is obtainable in the bazar and is said to be carminative, tonic and anthelmintic.

Semecarpus anacardium Linn. (see page 385)

Sesamum indicum DC.

VERN.—Sans.—*Tila, Snehaphala, Tila-taila* (oil), *Tilaha* (seed) ; Hind.—*Til, Tir, Krishna-tél, Mithá-tel, Til-ká-tél* ; Beng.—*Tél, Til, Kala til, Sumsum, Chadu til, Rakta til, Sánkí til* ; Bomb.—*Til, Tal, Krishna-til, Barik-til, Ashádi-tal* (white), *Kala katwa* (black) *Purbia* (red) ; Punj.—*Til, Tili, Kunjad* ; Tam.—*Nal-lenny* (oil), *Yellú-cheddie, Ellu* (seed) ; Tel.—*Nuvvu, Nuvvulu, Manchinúne* (oil), *Polla nuvvulu* (seed) ; Kumaon—*Bhunguru, Til* ; Santal—*Tilmin* ; Pers.—*Kunjad* (seed), *Roghane kunjad* (oil).

The oil expressed from the seeds is known in the bazar as 'til' oil. It is a good substitute for olive oil and can be used as an emollient in dressing wounds and ulcers. It was previously held to be a good application in cutaneous lesions of leprosy. On account of its high mucilage content, the leaves are given a high place in the treatment of chronic dysentery. The seeds have been used to produce abortion. A hot hip bath with some bruised seeds in it is said to give relief in dysmenorrhœa.

Sida cordifolia Linn. (see page 387).

Smilax china Linn.

VERN.—Sans.—*Chobachini* ; Hind., Beng., Punj. & Bomb.—*Chobchíní, Shúk-chíná* ; Tam.—*Paringay* ; Tel.—*Pirangi chekka, Gáli chekka* ; Sing.—*China-alla*.

The root is imported from China and is available in the bazar. Decoction of the root (2 ounces in a pint of water) after boiling for some time is said to be a good alterative and tonic in doses of 1 ounce thrice daily.

Sodii biboras.

VERN.—Sans.—*Tan-kana ;* Hind.—*Sohágá, Tinkál ;* Beng.—*Sohágá, Suhágá ;* Bomb.—*Kuddia-khár, Tankan-khár ;* Punj.—*Sohága, Tinkár, Tinkal ;* Tam.—*Venkáram, Vengáram ;* Tel.—*Velligáram, Elegáram ;* Pers.—*Tinkár tankár ;* Kash.—*Vavut.*

Borax is a common bazar drug and occurs in an impure condition. It can be purified by dissolving it in water, straining through cloth and evaporating to dryness. The local application of borax 1 drachm in an ounce of honey or other suitable vehicle, is useful in ulceration of mouth and cracks and fissures of tongue. In sore nipple, prickly heat and other forms of skin eruptions, it can be advantageously employed. A useful ointment is prepared by a combination of the following substances:—borax 1 drachm, sulphur 1 drachm, catechu 1 drachm, ghee 1 ounce. Doses varying from 10-30 grains are given in prolonged labour, disorders of menstruation and other forms of uterine affections.

Solanum dulcamara Linn.

VERN.—Punj.—*Rúba barík* (=the leaves).

Dulcamara grows in the Western Himalayas from Kashmir to Gharwal, but a certain quantity is also imported into India from Persia. A decoction of the berries (1 to 2 ounces in a pint of water) is a suitable diuretic, diaphoretic and alterative mixture. Dose 1 to 2 ounces. It has also been given in syphilis, leprosy, chronic rheumatism and various skin diseases.

Solanum nigrum Linn.

VERN.—Sans.—*Kákamáchi ;* Hind.—*Makoi ;* Beng.—*Gurkámái, Kákmáchi, Tulidun ;* Bomb.—*Kámuni, Ghátí ;* Punj.—*Kámbei, Káchmách ;* Tam.—*Munna-tákali-pullum, Manattak-kali;* Tel.—*Kanchi-pundu, Káchi;* Arab.—*'Anb-us-sá'lap.*

The black berries of this plant have been used as diuretic and diaphoretic for a long time in heart diseases when attended with swelling of the legs and feet. Freshly prepared extract from all portions of the plant, the berries, the leaves and the stem is also used in doses of 1-2 drachms. It is said to be effective in cirrhosis of liver.

* **Solanum trilobatum** Linn.

VERN.—Sans.—*Alarka ;* Uriya—*Nabhi-ánkuri ;* Tam.—*Tudavullay ;* Tel.—*Uchchinta, Uste.*

This is a common shrub of Southern India. A decoction of the root and leaves is given in consumption.

Solanum xanthocarpum Schrad.

VERN.—Sans.—*Kantákari, Nidigdhika*; Hind.—*Katelí, Katai*; Beng.—*Kantakari*; *Bomb.—Bhúringni, Ringni*; Punj.—*Warúmba, Mahorí, Mamoli*; Tam.—*Cundung katric, Kandan-kattiri*; Tel.—*Pinna mulaka, Vankuda.*

The root is one of the important medicinal ingredients of the Hindu physicians and has been recognised for a long time as an effective diuretic, expectorant and febrifuge. A decoction of this root with that of *Tinospora cordifolia* is said to be a tonic in fever and cough.

Strychnos nux vomica Linn. (see page 248).

Strychnos potatorum Linn.

VERN.—Sans.—*Kátaka, Ambu-prasádu*; Hind.—*Nirmali, Nelmal, Neimal*; Beng.—*Nirmali*; Bomb.—*Nirmali, Gajrah*; Punj.—*Nirmali*; Tam.—*Tetan-kottai, Tettian*; Tel.—*Induga, Katakamí, Chettu*; Sing.—*Ingini.*

This tree is plentiful in Southern India. The seeds rubbed with a little honey and camphor are a favourite remedy with the indigenous practitioners in chemosis of the conjunctiva and profuse lacrymation. The seeds have been advocated by the Mohammedan physicians in chronic dysentery. Dr. Mohideen Sheriff in his *Materia Medica of Southern India* mentions the use of the pulp of the fruit in dysentery as a substitute for ipecacuanha.

Sulphur.

VERN.—Sans.—*Gandhaka*; Hind.—*Gundhak*; Beng.—*Gandhak*; Punj.—*Gandhak, Kibrit, Anwlásár, Gogird*; Tam.—*Gandakam*; Tel.—*Gandhakam*; Pers.—*Gangird.*

Sulphur is easily procurable in the bazars of India. The Hindu physicians describe four varieties of sulphur—the yellow, the white, the red and the black. The yellow variety is preferred for internal administration while the white variety is preferred for external application. In many households sulphur is used to disinfect rooms by fumigation. In scabies and many other parasitic diseases of the skin, powdered sulphur in ½ chattack of bland oil is an efficient remedy. Internally, sulphur is a mild laxative and in combination with honey or milk is frequently prescribed in habitual constipation especially when complicated with piles.

Symplocos racemosa Roxb. (see page 390).

Tamarindus indicus Linn.

VERN.—Sans.—*Amliká, Tintidi, Tintili, Ambia*; Hind.—*Amli, Anbli, Imli, Amlicá*; Beng.—*Téntúl, Ambli, Tintil*; Bomb.—*Amlí, Amblí,*

Chintz ; Punj.—*Imlí* ; Tam.—*Púli, Puliyam-pazham* ; Tel.—*Chinta-pandu, Asek* ; Sing.—*Siyembela* ; Pers.—*Anbalah* ; Uriya.—*Tentúli.*

The tamarind tree is common throughout India and has been valued as a medicine from remote times. The pulp of the fruit boiled with water and sweetened is a refrigerant, carminative and laxative and is much prescribed in febrile affections. The red outer covering of the seeds is considered to be a valuable remedy in diarrhœa and dysentery. For this about 10 grains of the powdered seeds with equal quantity of cumin seeds and sugar are given two or three times daily. In the absence of lemon, tamarind can be used for its antiscorbutic properties. The ripe pulp of the fruit is considered to be a very effective laxative in habitual constipation and enters into many of the medicines of the Hindu physicians. The leaves are astringent and can be used as a gargle or made into a poultice, are applied to inflammatory swellings.

Tamarix gallica Linn.

VERN.—Sans.—*Jhávuka, Shávaka* ; Hind. & Beng.—*Jháv jháu* (galls = barí-máín) ; Bomb.—*Jháv-nu-jháda, Jhan, Lei, Lái* (galls = *magiya-máin*) ; Punj.—*Pilchí, Koá, Jhau* (galls = *mahín, Barí-mahín*) ; Tam.—*Atru-sha-vukku, Kóta-shavukku* ; Tel.—*Eru-saru, Shiri-saru* ; Pers.—*Shór-gaz* (galls = *gazmázaj*).

This shrub grows abundantly in India specially along the sandy localities. On its branches small tuberculatous galls are produced by puncture by insects. These are globular in shape, are about the size of a nutmeg and have a bitter astringent taste. Most of the galls used in pharmacopœial preparations are derived from Oak-galls which is the imported variety. The percentage of tannic acid in the Indian galls is large enough for their use in British Pharmacopœia. A strong infusion of the galls is a good astringent gargle in stomatitis and sore throat. An infusion of the bark or the galls (4 to 5 ounces in a pint of water) is useful in doses of 1-2 ounces, in diarrhœa and dysentery ; it is preferably combined with infusion of Chiretta. Powdered gall 1 to 2 drachm, opium ½ drachm with an ounce of vaseline or any non-irritating oil forms an efficacious ointment in ulcerating piles and anal fissure in place of the official 'unguentum galle cum opio'.

Taraktogenos kurzii King. (see page 391).

Taraxacum officinale Wigg.

VERN.—Punj.—*Dúdal, Baran, Kanphúl, Dúdlí, Dúdh batthal, Shamúke* ; Bomb.—*Bathur.*

Taraxacum occurs in the temperate Himalayas and to some extent also in the Ootacamund hills. Most of the taraxacum that is used in

the preperation of the pharmacopœial drugs is imported. The indigenous root is somewhat smaller than the imported variety but is effective. Powdered root in doses of 10-15 grains is believed to be a hepatic stimulant. Decoction of the root in doses of 1-2 ounces, combined preferably with podophyllum is useful in jaundice, hepatitis and indigestion.

Taxus baccata Linn.

VERN.—Hind.—*Thúno, Birmí, Zirnub birmí ;* Beng.—*Sugandh, Burmic, Bhirmic ;* Bomb.—*Barmi* (leaves=*tálispatr*); Punj.—*Birmí, Túng, Barma, Rikhái, Thona* (leaves=*birmí*) ; Khasia—*Dingsableh ;* Kumaon—*Thaner, Thúner, Gallu ;* Kash.—*Túng, Sungal, Postil, Chatúng.*

It is a large tree sometimes attaining a height of about 100 feet growing in the temperate Himalayas, upper Burma and the Khasia hills. To the leaves has been assigned a property somewhat similar to Digitalis. The leaves are available in most of the towns in Northern India and are used as sedative and emmenagogue. They are often prescribed in hysteria, epilepsy and nervousness. According to Dymock the leaves, to some extent, constitute the 'talispatra' (*Abies webbiana*) of the Sanskrit writers, but this seems doubtful.

Terminalia arjuna W. & A. (see page 401).

Terminalia belerica Roxb.

VERN.—Sans.—*Vibhitaki, Vipitakaha, Akasha, Bahira ;* Hind.—*Bhairá, Baherá, Behra, Sagoná, Bharlá, Buhura ;* Beng.—*Bohera, Baheri, Bhairah, Buhuru, Boyra ;* Punj.—*Bahira, Bahera, Birha, Balela, Bayrah ;* Bomb.—*Behara, Behada, Behda, Bherdha, Balra, Bahudda, Yella, Goting, Yel, Behedan, Behasá ;* Mar.—*Bherda, Bahedá, Bahera, Sagwan, Bedá, Yeheľa behadá ;* Tam.—*Tani, Thani, Kattu elupay, Tanrik-káy, Tandi tonda, Chattu-elupa, Tamkai, Vallai-murdú, Tanikoi ;* Tel.—*Tani, Tandi, Thandra, Thana, Tádi, Katthu-olupœ, Tándra káya, Bahadrha.*

Myrobalan is common throughout India. Two forms occur in the bazars, one being twice the size of the other. In the Hindu medicine *T. bellerica* was largely used in combination with *P. emblica* and *T. chebula* in diseases of the liver and gastro-intestinal tract. The unripe fruit acts as a laxative and the dried ripe fruit as an astringent.

Terminalia chebula Retz.

VERN.—Sans.—*Haritaki, Abhayá, Pathya ;* Hind.—*Har, Harara* (tree), *Har, Pile-har, Bál-har, Zangihar, Kálehár* (fruit); Beng.—*Haritaki, Horá ;* Punj.—*Har, Harrar, Hurh, Halela* (tree), *Har* (fruit);

Bomb.—*Hirda, Hardá, Har, Hiradá, Bála hirade, Harle, Pilo-harle, Hardi* ; Tam.—*Kada kái, Kaduk-kay* (tree), *Kaduk-káy, Kaduk-kay-pinji* (fruit); Tel.—*Karaka, Kadukar, Kurka* (tree), *Karakkáya, Pinda karakkáy* (fruit).

The bazar myrobalans have a pale buff colour, are oval in shape and have longitudinal ridges on the surface. They are composed of dry pulp with a stone-like kernel inside. The taste is astringent. Myrobalans are mild and efficient laxative. The following preparation is generally used as a household remedy:—bruised myrobalans 6 in number, cloves 1 drachm, water 10 oz., boiled for ten minutes and strained. The dose should be administered early in the morning. Owing to the large amount of gallic acid the myrobalans contain, they can be used externally as a local application in chronic ulcers and wounds or as a gargle in stomatitis.

Thespesia populnea Corr.

VERN.—Sans.—*Gardha-bhánda, Párisa* ; Hind.—*Parsipu, Pipal, Porush, Bhendi* ; Beng.—*Pares pipal, Pálas pipal, Pórash* ; Punj.—*Páras pipal* ; Bomb.—*Bhendi, Pálas piplo, Parsipú, Rán-bhendi, Parsacha-jháda* ; Tam.—*Purasha, Purvarasam, Puarasu, Pursung, Poris* ; Tel.—*Gangarenu, Gangarávi, Muniganga rávi.*

This tree grows along the sea coast of India and is cultivated to some extent in Madras. The leaves mixed with some bland oil are a favourite remedy in inflammatory swellings. The juice of the fruit is mentioned by Ainslie to be employed in various skin diseases specially in what is called 'Malabar itch'.

Tinospora cordifolia Miers.

VERN.—Sans.—*Gudúchi, Amrita, Sóma valli,* Hind.—*Gurach, Gulanchá, Giloe* ; Beng.—*Gulanchá, Gurach, Gadancha, Paló* (extract) ; Punj.—*Gilo-gularich, Gilo, Garham, Palo, Sat-gilo* (extract) ; Bomb.—*Gulwail, Gharol, Gado, Galo* ; Mar.—*Gula-veli* ; Tam.—*Shindil-kodi, Shindil-shakkarai* (extract) ; Tel.—*Tippa-tige, Guluchi, Guricha, Manapála, Tippa-tige-sattu* (extract), *Tippa-tege-véru* (root).

It is commonly known in the bazar as 'gulancha'. The stem and root are used medicinally and have a bitter taste. The watery extract of the plant was much used as a febrifuge and was given the name of 'Indian quinine'. An infusion is prepared from the stem and root which is a valuable tonic in debilitating diseases, intermittent fever and dyspepsia. Though several authors have spoken highly of its usefulness in leprosy, secondary syphilis and gout, its efficacy in these diseases is doubtful.

Tribulus terrestris Linn. (see page 408).

Trichosanthes cucumerina Linn.

VERN.—Sans.—*Patola* ; Hind.—*Jangli-chi-chonda* ; Beng.—*Ban-patol* ; Punj.—*Gwal, Kakri* ; Bomb.—*Jangli-padavala, Rán-parul, Kadu-padavala, Ránáchapadavali, Patola* ; Tam.—*Káttup-pepudal, Pudel* ; Tel.—*Adavipotla, Patolamu, Cheti-potla.*

T dioica Roxb.

VERN.—Sans.—*Patola* ; Hind.—*Parvar, Palval* ; Beng.—*Potól* ; Punj. *Palwal* ; Bomb.—*Potala* ; Tam.—*Kombu-pudalai* ; Tel.—*Kommu-potla.*

The fruit of the species 'patola' is described by the Sanskrit writers as febrifuge, laxative and antibilious. In Bengal the fruit of *T. dioica* is considered to be the 'patola' of the Hindu physicians. The juice of the leaves and the fruit is mentioned as a cholagogue and aperient. The root is a drastic purgative.

Tylophora asthmatica W. & A.

VERN.—Hind.—*Jangli pikván, Antamúl* ; Beng.—*Anto-mul* ; Bomb. —*Pitmari, Kharaki-rásna, Anthamul, Pitakári* ; Tam.—*Nach-churuppán, Nanjamurich-chán, Náy-pálai* ; Tel.—*Verri-pála, Kukka-pála.*

The plant is very commonly met with in low and sandy localities. It has been used extensively in indigenous medicine and for this purpose the root and the leaves are preferred. The root has attached to it many tender fibrils, sometimes about 20 in number. Ten to fifteen grains of the dried leaves or root 2-3 times daily are said to be useful in dysentery. It is also useful as an expectorant in chronic bronchitis.

Uncaria gambier Roxb.

VERN.—Hind.—*Kath kutha* ; Bomb.—*Chinai katha* ; Tel.—*Ankudu kurra* ; Malay—*Gambir.*

Gambier is an extract from the stem and leaves of *U. gambier.* It is imported into the markets of India from Java, Sumatra, Penang and Singapore. It is known as 'pale catechu' to distinguish it from *Acacia catechu* which is indigenous to India. All the preparations of catechu in the British Pharmacopœia are derived from this imported source. It has a bitter astringent taste and is a well-known local astringent. The officinal tincture diluted with water can be used as a gargle in sore throat, stomatitis, etc. Internally, in combination with chalk, kino and opium, it is a useful preparation in diarrhœa and cholera.

Urginea indica Kunth. (see page 252).

Valeriana wallichii DC. (see page 255).

Vateria indica Linn.

VERN.—Hind.—*Sufed-dámar, Kahruba* ; Beng.—*Chundrus* ; Bomb.—*Rál* ; Tam.—*Vellai-kunrikam, Vellai-dámar, Velli kundricum, Painipishin, Vellai-kungiliyam, Dhup maram* ; Tel.—*Dupa-dámaru, Tella dámaru, Dupada* ; Malay—*Payana, Vella-kunturukkam, Painipasha, Vella kondrikam.*

The resin from *V. indica* is white 'dammar' ; the black variety is obained from *Canarium strictum.* The resin forms a good emollient for plasters and ointment basis. The oil obtained from the seeds is a reputable local application in chronic rheumatic inflammation of the joints.

Vernonia anthelmintica Willd. (see page 409).

Viola odorata Linn.

VERN.—Hind.—*Banafshah* ; Beng.—*Banosa* ; Bomb.—*Banafshah, Baga banósa, Banaphsa* ; Tam.—*Vayilettu.*

The flowers and the root of *V.odorata* are known in the bazar as 'banafshah'. It is met with in Kashmir at an altitude of about 5000 feet from where it is brought to the plains and is sold as a valuable remedy in various ailments. It is considered to be a diuretic, diaphoretic and aperient. An emetic principle named *violin* was isolated from it, but O'Shaughnessy found the drug ineffective in dysentery. Mohideen Sheriff advoated the use of the drug in fever to allay the distressing symptoms. An infusion (2 drachms of the flower in a pint of warm water) is given as a cooling mixture in fever in doses of 1-2 ounces.

Vitex negundo Linn.

VERN.—Sans.—*Sveta-surasa, Vrikshaha, Nirgundi* ; Hind.—*Sanbhalu, Nirgandi, Nisinda, Mewri, Sambhálu* ; Beng.—*Nishindá, Sámálu, Nirgundi* ; Punj.—*Marwan, Máura, Banna, Torbanna, Swanján, Mawu, Amalu* (root & leaves), *Bari* (fruit) ; Bomb.—*Nirgundi, Katri, Shiwari, Nisinda Nirgunda, Lingur, Nirgari* ; Tam.—*Vellai-noch-chi, Nochchi* ; Tel.—*Tella-Vávili, Vávili, Nalla-vávili.*

V. trifolia Linn.

VERN.—Sans.—*Surasa-Vrikshaha, Jala-nirgundi* ; Hind.—*Páni-ki-sanbhálu, Sufed-sanbhálu* ; Beng.—*Pánisamálu* ; Tam.—*Nir-noch-chi, Shiru-noch-chi* ; Tel.—*Niru-Vávili, Shiruvavili.*

V. negundo and *V. trifolia* are both common bazar drugs and the properties are considered to be similar. The leaves are heated and are applied to painful and rheumatic swellings. Macerated leaves made into a paste with water are given as a cooling application on the forehead in headache.

Vitex peduncularis Wall. (see page 411).

Vitis quadrangularis Wall.

VERN.—Sans.—*Vajra-valli, Asthisanhara* ; Hind.—*Hár-jorá, Nallar, Harsankar* ; Beng.—*Hasjora, Harjorá, Hárbhángá* ; Bomb.—*Harsankar, Hárjorá, Nallar, Kandavela, Chodhári* ; Tam.—*Perundei çodic* ; Tel.—*Nalleru, Nulle rutigeh.*

The leaves and stem are frequently taken with curry in Southern India. In Madras, the young shoots of the plant are burnt to ashes in a closed vessel and administered in dyspepsia and indigestion. The juice of the stem is said to be useful in otorrhœa and epistaxis.

Wrightia antidysenterica (see Holorrhena antidysenterica, page 326).

Zingiber officinale Roscoe. (see page 257).

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